



UGANDA PROTECTORATE

ANNUAL REPORT
OF THE
DEPARTMENT OF
AGRICULTURE

FOR THE PERIOD

1st July, 1944—30th June, 1945

PART II

Published by Command of His Excellency the Governor

ENTEBBE
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ANNUAL REPORT OF THE SENIOR PLANT PATHOLOGIST.

I was on duty throughout the year. In September, 1944, a visit with the Senior Botanist was paid to the I.N.E.A.C. Experiment Station at Mulungu, Kivu, in connection with the virus of sweet potatoes, mentioned below.

Plant Diseases.

SWEET POTATO VIRUS DISEASE.

During 1944 a virus disease appeared on the Kawanda stock collection of local varieties of this crop, and on some was particularly severe both in incidence and effect on the plants. Comparison with symptoms shown on other varieties in the Belgian Congo, at Mulungu, shows that the disease in some of its forms at Kawanda is identical with that in the Congo. In Uganda the disease is most severe in the western districts, and a cursory survey made by the Senior Botanist indicates that although it occurs almost everywhere in Uganda, its incidence in the eastern and northern districts is very small. The present distribution, therefore, indicates a spread from the south-west of Uganda where it is possible it has been introduced from the Congo; alternatively, this area may represent the site of the original outbreak.

All varieties of sweet potato grown at Kawanda are susceptible to infection, as are the seedling varieties raised at Mulungu by the Belgian workers. On the other hand there is great variation in incidence on varieties grown side by side at Kawanda, and some appear to be much more resistant to infection than others. Also, the appearance of the disease on different varieties shows every degree of severity—on some varieties it is merely a mild mosaic, while on others it causes severe dwarfing, leaf distortion, etc. Trials are being made to obtain some information on the effect of infection on crop production of local varieties at Kawanda.

In view of the great range of symptoms so far observed it is possible that more than one virus is concerned in this disease complex, and work has been commenced at Amani to investigate this point, as well as to discover the insects responsible for spread of the disease to healthy plants. Information so far obtained at Kawanda indicates that the most susceptible period in the growth of the plant is within the first two months after planting the cuttings, and that after the plants have commenced to form a ground cover, the spread of the disease is extremely slow. At Mulungu, where very large numbers of seedlings are being raised for test, infection spreads very rapidly on the young seedlings, and, as at Kawanda, it is suspected that a white fly (? *Bemisia* sp.) is concerned in this spread. In this connection it is noteworthy that the late Entomologist in Uganda, Mr. H. Hargreaves, during the course of several years of detailed work on sweet potato pests, 1920–1934, obtained no record of such an insect on the crop, though at present it is very prevalent at Kawanda and could not be missed.

During the 1945 planting of the trial plots at Kawanda it was found that the great majority of diseased cuttings rapidly died out, and this may account in part for the hitherto minor importance of the disease in the surrounding district. With some varieties which show severe infection types, it was found very difficult to raise plants from infected cuttings, even under very favourable weather conditions. The peasant cultivator could hardly miss this point, and in consequence would discard such heavily infected varieties and concentrate on others. It is, therefore, possible that the virus has existed around Lake Victoria for some years longer than was at first suspected, and that a natural balance is being attained with the tolerant varieties now in

cultivation. On the other hand there is a risk that the disease may accumulate further in stocks of native varieties and the tolerance of these may break down at any moment.

The host range of the virus is not known, but wild *Ipomoeas* and related plants, when planted in the vicinity of infected sweet potatoes, have been observed to show symptoms of virus infection, in some cases even in severe form. At present a collection is being accumulated of wild african *Ipomoeas*, as well as species from other parts of the world, in order to discover a source of high resistance or immunity, which might be transferable to the sweet potato by hybridisation. So far great difficulty has been experienced in getting many of these wild species to grow under field conditions at Kawanda, as many appear to require the moist conditions of swampy forest.

A general account of this disease and its symptoms was published in the East African Agricultural Journal, 1945.

STEM ROT OF SWEET POTATO.

On some of the varieties grown at Kawanda a severe stem rot occurs, characterised by black lesions at first limited to the surface tissues, but later penetrating the stem and rendering it very brittle, and finally often causing the death of the parts beyond the lesion. Cultures from the diseased tissues have yielded a number of different fungi, amongst which is a species of *Plenodomus*, more or less corresponding to that described in the U.S.A. as causing a severe stem disease of the crop (*P. destruens*). Observations in Uganda, the Belgian Congo, and in Tanganyika, show that this disease is widespread, but at Kawanda it is limited more or less entirely to certain varieties, while a few others very rarely show any sign of attack. The disease in Uganda is unlikely to become severe enough to affect the native crop as a whole, as the cultivator would naturally tend to concentrate on the more resistant types, of which there are a fair number.

The whole question of varieties of sweet potato grown by the peasant cultivator appears to be at present in the melting pot; years ago it was considered that he was rather conservative in the matter and unwilling to change from one variety to another, but experience during recent years of drought has shown that he has changed rapidly to varieties which stand up well to dry weather. At the same time yield as such is not necessarily the reason for his choice of varieties, as he has distinct preferences for some on account of such qualities as flavour, early or late maturity, keeping qualities after lifting, etc. Consequently in raising new varieties for his use, resistant to virus or to Stem Rot or to both diseases, we must present him with a rather wide range of choice.

BANANA DISEASES.

During the rather long periods of drought experienced of late years, the leaf spot diseases appear to have increased in prevalence and that due to *Cercospora musae* has become quite common around Kampala, whereas years ago it was more or less a scientific curiosity and limited to old moribund leaves. This recent increase in incidence, and spread to younger leaves is probably correlated with the known deterioration in soil and cultivation conditions of the crop in this area. At present the disease cannot be regarded as a major factor in reduction of crop. A few cases have been seen of a rot of the heart leaf, due to attack by *Helminthosporium musae-sapientum* at some point within the heart of the plant before the leaf has expanded. The infection commences as a spot on the leaf-blade, of water-soaked appearance, and spreads from its original entry by contact with the adjacent portions of the leaf while still tightly rolled, so that a band of infected tissue is formed some way down the leaf from the tip; later the distal part of the leaf dries up

completely. From infected leaves a pure culture of the fungus was easily obtained, and no other fungus or bacterium was found present. So far the disease in this form has been found only on the plantains used for cooking, while the small eating banana (of "lady finger" type) was unaffected, though growing mixed with the plantains.

A note on diseases of this crop was published in the East African Agricultural Journal during the year.

DISEASES OF IRISH POTATO.

Phytophthora Blight continues to be of major importance in the more elevated parts of Uganda, notably in Kigezi and Toro. Experience with available varieties in this district indicates that of those at present available, the most reliable is a blue type of unknown origin. While this is by no means highly resistant to infection, it is capable of forming a reasonable crop prior to the death of the foliage and stems after epidemic attack.

At Kawanda experience during the past four years has shown that severe attacks are comparatively rare, and for this reason the station is not suitable for conducting comparative trials of resistance and crop production in connection with this disease.

Alternaria Blight, often accompanied by *Cercospora* attack is the usual disease of importance on this crop at Kawanda, and presumably in native cultivation in the vicinity of this station. Owing to climatic differences within a range of a very few miles, however, this may not be true of other areas around Kampala and Entebbe; here the crop is grown on a limited scale in small scattered plots, for sale in the markets of the townships, and detailed information is difficult to obtain, especially as the crop is planted whenever weather conditions permit, and a single plot may have been sown at widely separated times, containing plants of all stages of maturity.

When conditions permit, it is very desirable that a whole series of new potato varieties be introduced into Uganda, especially the newer varieties reputed more or less resistant to *Phytophthora* Blight.

Virus diseases of the crop are common everywhere in Uganda, but no detailed work has been done here on these.

COTTON DISEASES.

Selection and breeding for resistance to Black Arm and Wilt Disease are now part of the routine programmes of the cotton breeding stations, and assistance has been given as and when required.

Herbarium.

The collection and determination of Uganda Fungi has been continued whenever possible; the results are in course of publication in a series of papers sent to England, though war conditions have retarded publication. During the year a large collection of *Meliola* and related fungi from West Africa, made by Deighton in Sierra Leone, was examined in detail and a complete account is in course of publication. Similar collections were received from Ceylon and from India, while at present arrangements are being made with Harvard University to work through the very large collections there, with a view to preparation of a complete world monograph of this group of fungi. A number of more general collections were received for determination from Mr. Hendrickx, Belgian Congo, from Dr. Wallace, Tanganyika Territory, and from Dr. Thirumalachar, Mysore, India.

Little work has been possible in the Phanerogamic Herbarium, as few determinations have been received of Uganda plants from Kew during the year. We hope shortly to receive lists of determinations of the large collections made prior to the war by Chandler, Purseglove, Thomas and Hazel, which are still lying at Kew unnamed. When these determinations have been

completed the Kawanda Phanerogamic Herbarium should contain specimens of well over 90% of all plants hitherto recorded in the Protectorate and thus form an extremely valuable reference collection.

Bacterial and Fungus Flora of Uganda Soils.

In connection with the soil structure work conducted by the Chemical Department at Kawanda, preliminary work has been commenced on the flora of Kawanda Soils, in relation to cultivation history. So far this has consisted merely of isolation of the various organisms in pure culture, as a preliminary step towards numerical counts of their prevalence. The soils examined have, as far as is known, never been grazed by cattle, certainly not within the last thirty years at least.

Sugar Industry.

A few varieties of Co type were obtained from Natal during the year, but arrived at an unfortunate period, and after planting were subject to several months of drought, during which most of them died out. None showed any promise of being useful in Uganda plantations, but were imported primarily for test at Kisumu in Kenya, where conditions are very different from Uganda. Experience in Uganda has shown that the Co canes tried here in the past are inferior to POJ 2725, still our standard variety. During the drought of 1943-44 the variety POJ 2878 was found to suffer more severely than POJ 2725, and the stands contained rather a high proportion of hollow dry canes. When planted in old swamp areas, however, this variety gives very heavy returns, averaging commonly above 90 tons per acre at 18-20 months.

Advice on plantation and factory working was given to the sugar estates from time to time, as requested. One case of a field of Co 290 showing heavy leafspot infection by *Cercospora* was encountered during the year, but little evidence of any effect on crop production was obtained, though the field appeared very unsightly. The variety is now being abandoned as inferior to POJ 2725.

Mycological Conference.

A conference of East African Mycologists was held at Kawanda in February, 1945, at which the main subjects discussed were the diseases of Irish and Sweet Potatoes.

C. G. HANSFORD,

Senior Plant Pathologist.

ANNUAL REPORT OF THE SENIOR ECONOMIC BOTANIST.

I returned from leave by air, arriving in Uganda on 13th August. A few visits were paid from Kawanda to various estates in Buganda and to the Botanic Gardens, Entebbe. Four visits were paid to Kakumiro, in connection with the thinning of the cinchona plot and the collection of seed, and three visits were paid to Toro to give advice about the planting of cinchona and of tea.

Coffee.

Selection Plots.—All the coffee at Kawanda continued to recover from the effects of the drought, but the crops were poor on the older trees:—

1935 Robusta	...	63 lbs. clean coffee per acre.
1935 Nganda	...	95 lbs. clean coffee per acre.
1937 Robusta	...	1,570 lbs. clean coffee per acre.
1934 Nganda	...	550 lbs. clean coffee per acre.

All these plots had ripened small crops when young, but did not come into good production until after three years; since then their average annual yields have been about:—

1935 Robusta	...	1,200 lbs. clean coffee per acre.
1935 Nganda	...	1,000 lbs. clean coffee per acre.
1937 Robusta	...	1,270 lbs. clean coffee per acre.
1937 Nganda	...	700 lbs. clean coffee per acre.

The 1937 Nganda block is on a patch of lateritic gravel, such as would be avoided on a commercial plantation, but nevertheless the yields on it are as good as those recorded in other countries; and the yields of the other blocks are considerably greater. Furthermore, these yields are undoubtedly under-estimated; they are calculated on the basis of 1 clean coffee to 5 fresh cherry, but sampling shows that the ratio is usually about 1:4.7; and they take no account of blank spaces or of losses by theft. There was a very heavy flowering in January and a good crop has now formed in all blocks, especially on the Nganda trees. The system of cultivation—clean weeding with the minimum disturbance of the soil, and narrow base bunds with ditches below—has led to terracing of the land and complete control of the runoff; and, as the trees become bigger, the cost of weeding is becoming very low.

2. *Coffee Costings Plots.*—These plots also recovered from the effects of drought and most of them are bearing good crops this year. The costs and yields of the plots for the last two years are summarised in the table on p. 6. Each plot is 50 yards wide and 100 yards long and therefore has an area of 1.03 acres. Individual tree records of crop as fresh cherry are kept and the yields, given as parchment, are one quarter of the weight of fresh cherry, which is an underestimate. The price of labour is reckoned at 50 cents per man-day, which was about the average in 1943 and 1944, and the price of parchment coffee as Shs. 750/- per ton, at which some of it was sold.

The costs which are given for cultivation do not include those of picking, which must be worked out later on a commercial basis; for, as the plots are made up of replicated progeny rows, individual tree records are kept and the picking gang also sorts and prepares seed for distribution, so that the labour employed is much more than under ordinary practice. The cost of planting has not been worked out yet; this cost also may need some adjustment for, owing to the previous mismanagement of the land, it was so infested with couch grass that 300 man-days per plot were needed to clean the ground after ploughing.

COFFEE COSTING PLOTS.

Plot.	Cost of cultivation.		Yields of parchment coffee.		Value of coffee.		Value of bananas.		Total return.
	Man-days	Shs.	lbs. 1943	lbs. 1944	Shs.	Shs.	Shs.	Shs.	
1. Nganda coffee. <i>Leucaena glauca</i> cover. No shade	297	148/50	31	27	19	19	Shs.	Shs.	19
2. Nganda coffee. Elephant grass mulch. No. shade	248	124/—	400	2010	810	810	..	..	810
3. Robusta coffee. Elephant grass mulch. No shade	239	119/50	1410	1620	1010	1010	..	..	1010
4. Nganda coffee at 15 ft. x 15 ft. bananas at 15 ft. x 15 ft. ..	227	113/50	30	7	12	83	..	..	95
5. Nganda coffee at 20 ft. x 20 ft. bananas at 10 ft. x 10 ft. ..	152	76/—	7	..	2	122	..	..	124
6. As in plot 5, but with barkcloth shade	151	75/50	1	..	..	113	..	..	113
7. Nganda coffee. Elephant grass mulch. Barkcloth shade	248	124/—	232	1140	460	460	..	..	460
8. Nganda coffee. Clean weeded. Barkcloth shade	142	71/—	255	840	366	366	..	..	366
9. Nganda coffee. Clean weeded. <i>Albizia stipulata</i> shade	174	87/—	187	432	207	207	..	..	207
10. Robusta coffee. Clean weeded. <i>Albizia stipulata</i> shade	167	83/50	384	610	334	334	..	..	334
11. Nganda coffee. <i>Leucaena glauca</i> cover. <i>Albizia stipulata</i> shade	322	161/—	5	3	3	3	..	..	3
12. Robusta coffee. <i>Leucaena glauca</i> cover. <i>Albizia stipulata</i> shade	320	160/—	51	5	19	19	..	..	19
13. Nganda coffee. Rows of elephant grass. Barkcloth shade	188	94/—	6	90	32	32	..	..	32

This experiment was designed as a long term one, in which coffee was to be regarded as a permanent crop, and therefore no definite results can be stated; but certain interesting facts are evident:—

(a) *Leucaena glauca*, which will suppress the growth of grasses in old coffee when both coffee and shade trees reduce the intensity of light near ground level, does not control couch grass in young coffee. The costs of cultivation on the plots under *Leucaena* cover have been the highest of all. Furthermore, the growth of the coffee has been greatly stunted and, although the bushes are now recovering from the drought, yet their growth is a year behind that of bushes on mulched or clean weeded plots. It is, of course, too early to condemn *Leucaena* as a cover, for its deep vigorous root system may eventually give beneficial results on Kawanda soils. Even the *Leucaena* plots required only about one man to two acres throughout the two years, which shows how cheaply coffee may be grown in Uganda on an experimental scale, when costs are bound to be higher than on a commercial plantation.

(b) Bananas also have somewhat retarded the growth of coffee, but the bananas themselves have given appreciable return; and this return would have been much greater if there had been no marked drought in 1943. The bushes under bananas are making good growth now and it is possible that the delay in fruiting may prove later to be an advantage in the building up of permanent trees. Costs of cultivation were abnormally high owing to an intense attack on caterpillar (*Metadrepana marantica*) while I was on local leave in 1943, and which was combated by hand picking, not by the cheaper method of spraying.

(c) Both barkcloth trees (*Ficus spp.*) and *Albizzia stipulata* are now beginning to provide some shade and shelter, but their effect is not yet marked. It seems that under the relatively dry conditions of Kawanda the barkcloth tree will prove to be better for interplanting with coffee than will *Albizzia*. Many of the *Albizzia* trees are recovering from the effects of the drought but those on plots 11 and 12, with *Leucaena* cover, are still very stunted.

(d) The cost of mulching has been more than justified by the extra crop; in fact, it is probable that the mulched plots 2 and 3 had paid for themselves by April, 1945 (the end of the picking season) when they were less than four years old. And comparison between the progeny rows on plots 7 and 8 has shown that mulching not only has increased yields but also has increased the bean size. In spite of the fact that the mulched plots have yielded well, yet their foliage has been very yellow and they have not looked as well as the clean weeded plots; this effect is especially marked on plot 3, which is bearing a good crop for the third year in succession.

(e) Not only are there differences between the plots, but also there are differences between the progeny rows on any one plot. Some rows are yellower than others when mulched; some are less affected by *Leucaena* competition—as a rule, the quick growing erect Robusta types can compete better than the slower growing spreading Nganda types. Therefore care must be taken to avoid making any definite statements on the trial at this stage; many more years of observation and record are needed to give final results.

3. *Self pollination*.—The collection of Robusta coffee at Kawanda contains some good types, but it is probable that better ones could be obtained by a long term breeding programme. Some of the trees on the 1937 Robusta block, raised from seed of self-pollinated selections on the Kampala Plantation, seem to be outstanding and it was intended to self pollinate these trees on a considerable scale. Unfortunately, the flowers opened in January during the strike, and pressure of other work made it impossible to deal with

more than a single primary branch on each of eight trees. As has been found before, there was a higher percentage of success than has been reported with self pollination of Robusta coffee in other countries; on one branch 40% of the flowers set fruits; in other cases the percentage was lower and, in pollinations of a second flush of flowers in March, little success was obtained. Assistance is necessary if any good programme of coffee breeding can be carried out; the pollination is tedious work and the trees must be watched for months afterwards to ensure that no fruit is set from sporadic flowerings.

Distributions of Seed.—During the twelve months there were distributed to departmental nurseries 2,170 lbs. of selected Nganda and 190 lbs. of Kent's Arabica coffee seed. If there were no wastage in the nurseries or in planting out, these large quantities of seed would lead to a very great increase in the population of coffee: and, in spite of the losses which do occur, the area under coffee has greatly increased. It is impossible to guess how long the new trees will last; when prices are high, large plots are looked after; when prices are low, large plots are neglected, become infested with couch grass and die out. A stable increasing production of coffee cannot be expected until the peasants regard coffee as a permanent crop, not a catch crop; in order to bring this about, coffee must be considered as individual trees, not as plots. There has been difficulty in the supply of the large amount of seed, which has involved much labour; and it has been obvious that the amounts requested for some districts were in excess of the nursery accommodation available. 600 lbs. of selected Robusta seed and 230 lbs. of selected Nganda seed were sold to various estates at a charge of Shs. 2/- per lb.

5. *Arabica Coffee.*—The observation rows of different varieties at Kyembogo and Kachwekano are beginning to show interesting features. At both places Kent's Arabica seems to be the outstanding variety, as it has been at Kawanda and in Bugishu. At both Kyembogo and Kachwekano many varieties have suffered from exposure; but one type, Abyssinian 1/11, is a strong grower and is resistant to exposure; it is usually the copper tipped types which tolerate exposure, but this one is green tipped.

Cinchona.

The plot at Kakumiro was thinned in August and September, 1944. The area of the Kakumiro plot is half an acre; it had been planted at a spacing of 6 feet square, but only 259 trees remained instead of the 500 for a full stand. All except the 81 best trees were dug out, their bark removed, dried at Kawanda and sold to the Totaquina Factory at Dar-es-Salaam. The bark was made up thus:—

Stem bark	...	2,510 lbs. 7.7% total alkaloids.
Branch bark	...	744 lbs. 5.4% total alkaloids.
Root bark	...	501 lbs. 4.2% total alkaloids.
Mixed bark	...	158 lbs. 4.3% total alkaloids.

3,913 lbs.

(The mixed bark was from 3 trees, cut out in September, to allow a good spacing for all the seed-bearing trees). The figures show how well quinine grows in Uganda; the Kakumiro plot was planted about 20 years ago, on land where Arabica coffee had died out; there has been no infilling and little weeding. Yet the thinnings alone amounted to nearly 4,000 lbs.; the remaining trees, which are the largest, may be estimated to have at least 50 lbs. each of bark, and the total yield would thus be 8,000 lbs., *i.e.*, 18,000 kg., per hectare; in the Dutch East Indies a yield of 10,000 kg. per

hectare is considered good. The quinine content of the bark is low, for the trees have passed their prime and the content falls off after the age of six years.

The remaining trees at Kakumiro are all strong in growth, with thick bark and with a good content of quinine. This plot now furnishes seed which is at least as good as any that may be obtained in bulk inside the British Empire and will be valuable until clonal seed plots come into bearing.

2. Small amounts of seed from 33 selected trees at Kitubulu, Kiwago and Kakumiro were sown in the beds at Kawanda. All the seed germinated well and the seedlings were pricked out in June; as space is limited, only 600 plants of each progeny can be raised. Observation blocks of 100 plants of the Kitubulu selections are already established at Kawanda; all surplus plants were sold.

3. Seed was supplied to Ndali Lake, Ltd., for their projected planting in Toro and to other estates. In several cases the seedlings raised were few in proportion to the seed sown, for too little attention was given to nursery management. A bulk of seed has remained unused.

Grasses.

Observation strips of 66 species and varieties of grass were established on a plot of poor, sloping, soil in the south-west of Kawanda station. The planting was done during a rainy spell in September; there were marked differences between the types as regards the rapidity with which they rooted and formed a cover over the soil. When grazing started, most interesting differences in palatability were observed, and some species, which were not liked in the rains, were relished in dry weather. Another difference which now is becoming evident is the persistence of different types; some strips now give little grass and are already badly infested with weeds—*Panicum maximum* and Kavirondo *Sorghum* are especially bad in this respect. It is too early to state any definite results, but the trial has shown how well some of the swamp grasses—*Echinochloa* spp., *Brachiaria mutica* and *Panicum repens*.—grow on dry land; and *Paspalum dilatatum* seems to be a much better grass for paddocks than *Paspalum notatum*—it grows quicker and is more palatable.

Botanic Gardens.

No major developments were made in the Botanic Gardens, Entebbe. The condition of the gardens was fairly well maintained although, owing to lack of spare parts for the mowers, the lawns were in poor condition during wet spells. More stone drains were built beside some roads, and the roads themselves were kept in fair condition. Nursery work continued as before and, as stocks of newer plants were increased, they became available for distribution. Total numbers of 7,684 economic plants (mostly fruit trees) and 4,987 decorative plants were distributed during the year.

A. S. THOMAS,
Senior Economic Botanist.

ANNUAL REPORT OF THE SENIOR CHEMIST.

Staff.

I was absent from the Protectorate on vacation leave in South Africa from the beginning of the period under review until the end of September. During that time I was privileged to see some of the grassland work being carried out at Cedara, Estcourt, Pretoria, and on the Witwatersrand University Farm. The posts of Chemist and European Laboratory Assistant have remained vacant through the year.

Native staff has been increased to six by the addition of two learners; other learners will be recruited as and when suitable applicants appear in order to train teams for work at Kawanda and Serere. They will deal with routine soil structure determinations to serve the areas West and East of the Nile respectively to speed up technical advice on the application of the grass rotation in the field.

The following is a summary of laboratory work carried out during the year.

TABLE 1.—SUMMARY OF LABORATORY EXAMINATIONS.

Soil.			No. of Samples.
Soil structure	...	...	710
Sticky point	...	...	710
Available nutrients	quantitative	...	10
Available nutrients	qualitative	...	272
Reaction	...	...	310
<i>Crops.</i>			
Nicotine in tobacco	...	...	13
Moisture	...	...	30

Soil Structure.

Investigations on the effects of resting and manuring on the physical aggregation of soil particles have been continued. Summaries of the earlier work on the subject which include the descriptions and designs of major field experiments have already been published (1, 2). It is only necessary to say that, having based the arable agriculture of the country on the maintenance of crumb structure, it is essential to study all aspects of crumb formation so as to evolve agricultural systems suited to different parts of the Protectorate and suited to peasant farmers' economy which in this case is one of labour. Outside comments and reviews of the work in Uganda have sometimes conveyed the impression that we are working entirely with elephant grass (*Pennisetum purpureum*). I should again emphasise the fact that we are concerned with all grasses. Elephant grass happens to be a feature of a broad belt of country from Ruwenzori to Elgon and is an excellent soil regenerator. It is also extremely valuable, if thickly planted, in keeping our local couch grass (*Digitaria scalarum*) in reasonable control. It is easily established but is most expensive of labour when the time comes to bring the land back to cultivation. We have therefore intensified our studies of other grasses to find an alternative resting cover bearing in mind the necessity of controlling couch at the same time.

This section of the report should be read as a follow up of the published papers. Only soil structure results will be given and no descriptions of

(1) W. S. MARTIN, Grass covers in their relation to soil structure. *Empire J. Expt. Agric.*, 1944, 12, 21-32.

(2) W. S. MARTIN, Soil Structure. *E. Afric. Agric. J.*, 1944, 9, 189-195.

experiments included unless they have not previously been described. The general agronomy will be found in the experiment station reports. The wet sieving records in the tables are obtained in two ways, one by using a bank of three sieves of mesh 2 mm., 1 mm. and $\frac{1}{2}$ mm. and the other by using only the $\frac{1}{2}$ mm. sieve. Normally the latter figure is considerably lower than the former and shows up treatment differences better, but as the published results were all obtained by use of the three sieve bank these figures are also included for comparison.

THE RESTING COVER AND TIME OF REST.

Four cycles of the fertility experiment at Serere have now been sampled, each at the end of a full circuit of its rotation. The results of wet sieving analyses using three sieves are given in Table 2.

TABLE 2.—SERERE FERTILITY EXPERIMENT, SOIL STRUCTURE.
% Water-stable crumbs over $\frac{1}{2}$ mm. diameter.

Resting Period.	Cycle I 1941	Cycle II 1942	Cycle III 1943	Cycle IV 1944
1 year's rest	35.6	32.5	38.4	50.3
2 years' rest	36.9	35.6	40.8	48.7
3 years' rest	42.0	37.6	43.0	57.4
Significant Difference ..	Linear and Linear quadratic		Linear	Quadratic
RESTING COVER.				
A Weeds	39.2	36.9	40.9	49.1
B <i>Cynodon</i>	39.1	34.5	39.3	51.7
C Legume slashed ..	36.8	36.1	41.8	58.8
D <i>Cynodon</i> slashed ..	39.0	36.8	42.1	51.6
E Legume dug in ..	36.9	31.9	39.7	47.3
Significant Difference ..	B + D > C + E	All > E	None	C > E

In all cycles rest restores soil structure and in three cycles out of four the digging in of a legume causes soil deterioration. The high figures for 1945 are due to a new method of soil preparation which will be discussed at a later date.

At Serere a six by six Latin Square was laid out to compare the following resting covers:—

- A. *Cynodon*.
- B. Sorghum undersown with grass seeds mixture.
- C. Elephant grass (*Pennisetum purpureum*).
- D. Pigeon Pea (*Cajanus indicus*).
- E. Sorghum followed by natural weed-grass succession.
- F. Cassava followed by natural weed-grass succession.

The results from the 1944 samples are given in Table 3 where the differences are not significant.

TABLE 3.—SERERE REGENERATION EXPERIMENT.

Treatment.	% Water-stable crumbs over $\frac{1}{2}$ mm.	
	Three sieves.	One sieve.
A	56.2	43.6
B	56.8	43.1
C	57.8	46.8
D	56.7	45.5
E	57.0	43.2
F	50.1	40.4
Significant difference ..	None	None

Corresponding data from the rotation experiment at Bukalasa reveal no significant differences this year as may be seen in Table 4.

TABLE 4.—BUKALASA ROTATION EXPERIMENT.

Treatment.	% Water-stable crumbs over $\frac{1}{2}$ mm.		
	Three sieves.	One sieve.	
Elephant grass rest 2 years	56.9	...	46.4
Elephant grass rest 3 years	52.6	...	44.7
Elephant grass rest 4 years	55.7	...	41.8
Natural regeneration 3 years	46.1	...	38.2
Significant difference	...	None	...

These results are surprising because the effect of the planted grass resting cover is usually quite definite even in the first year. The results from a randomised block experiment at Kawanda clearly demonstrate this. Here, six blocks of ten plots were first planted in November, 1941, infilled and sampled March–April, 1942, and again sampled at the same time each year for structure analysis. The different grasses compared and the results obtained to date are set out in Table 5.

TABLE 5.—KAWANDA—SOIL STRUCTURE DEVELOPMENT UNDER DIFFERENT GRASSES. 3 SIEVES.

Type of cover.	% Water-stable crumbs over $\frac{1}{2}$ mm.			
	1942	1943	1944	1945
<i>Pennisetum purpureum</i>	56.2	61.8	72.3	76.7
<i>Pennisetum polystachyon</i>	52.5	50.9	61.2	69.9
<i>Brachiaria decumbens</i>	56.7	61.7	70.8	79.0
<i>Cynodon plectostachyum</i>	57.9	59.4	67.5	76.9
<i>Chloris gayana</i>	56.8	59.3	68.0	74.6
<i>Hyparrhenia rufa</i>	55.1	54.7	61.1	74.5
<i>Setaria sphacelata</i>	58.2	55.2	66.8	73.7
<i>Panicum maximum</i>	59.0	52.4	64.5	73.5
<i>Rhynchelytrum repens</i>	55.3	49.7	63.2	71.5
<i>Paspalum notatum</i>	55.7	58.1	65.4	79.0

Even annual grasses have improved the physical condition of the soil but *Paspalum notatum* and *Brachiaria decumbens* head the list followed by elephant grass. Unfortunately neither of the short grasses is really capable of smothering *Digitaria scalarum*—the most persistent pest of native cultivation in the elephant grass areas of Uganda.

THE EFFECTS OF ORGANIC MANURES AND LIME.

The manurial experiments already discussed in published work have again been sampled during the year with the results given in the following tables.

TABLE 6.—SERERE FERTILITY EXPERIMENT.

% Water-stable crumbs over $\frac{1}{2}$ mm.

Treatment.	Cycle 1 1941	Cycle 2 1942	Cycle 3 1943	Cycle 4 1944
No manure	38.1	35.4	40.5	51.1
2½ tons F.Y.M.	38.5	35.0	41.7	49.6
5 tons F.Y.M.	38.0	35.4	40.0	49.7
Significant Difference	None	None	None	None

TABLE 7.—SERERE—MANURIAL EXPERIMENT.

	% Water-stable crumbs over $\frac{1}{2}$ mm.	
	Three sieves.	$\frac{1}{2}$ mm. sieve only.
Control	45.8	37.3
Lime	41.9	34.6
F.Y.M. 10 tons per acre	42.7	38.0
F.Y.M. 20 tons per acre	44.1	34.7
F.Y.M. 30 tons per acre	41.1	37.1
Significant difference	None	None

TABLE 8.—BUKALASA—MANURIAL EXPERIMENT.

<i>Treatment.</i>	% <i>Water-stable crumbs over $\frac{1}{2}$ mm.</i>			
	<i>Three sieves.</i>		$\frac{1}{2}$ mm. sieve only.	
A. Control ...	...	44.0	...	38.8
B. Cotton seed 4 tons ...	...	43.2	...	38.5
C. Green manure ...	...	40.7	...	37.1
D. B+C ...	...	42.3	...	42.9
Significant difference	...	None	...	None

At Serere another manurial experiment compares different levels of manuring with cotton seed and cotton seed meal combined with different methods of disposal of the residues of the cotton crop.

TABLE 9.—SERERE—COTTON SEED AND MEAL EXPERIMENT.

<i>Treatment.</i>	% <i>Water-stable crumbs over $\frac{1}{2}$ mm.</i>			
	<i>Three sieves.</i>		<i>One sieve.</i>	
Crop residues carted off ...	...	60.0	...	47.2
Crop residues burnt on ...	...	59.8	...	46.0
Crop residues dug in ...	...	60.7	...	49.4
Manuring:—				
Level 0 ...	...	60.4	...	49.5
Level 1 ...	...	58.1	...	44.9
Level 2 ...	...	62.0	...	48.2
Meal ...	...	60.2	...	46.8
Seed ...	...	60.1	...	48.2
Significant difference	...	None	...	None

The actual dressings applied are nil, one, and two tons of cotton seed meal per acre and double these quantities of cotton seed.

All the results from our field experiments therefore confirm those already published that under Uganda conditions:—

- Organic manures do not improve soil structure.
- Lime does not cause any water-stable aggregation of soil particles.
- Cultivation causes soil deterioration.
- Rest under a grass cover improves soil structure.

Analytical Methods.

The crumb percentages recorded this year are higher than those obtained in previous seasons. This may be partly due to slight changes in the preparation of the sample by a different operator. This does not affect the relative differences between treatments within the main plot experiments as each experiment is treated as a unit (*i.e.*, by the same operators) both in sampling and sieving. But a further critical study of sampling and sieving technique will be necessary before routine advisory practice can be established.

Another important question arises when dealing with soils of different types from widely separated areas. The crumb samples, air-dried and weighed after sieving in water may, and usually do, contain single grained particles (gravel or coarse sand) larger than $\frac{1}{2}$ mm. During the preliminary examination of the wet sieving method the crumb samples were dispersed, resieved through $\frac{1}{2}$ mm. dried and weighed. This figure was then deducted from the original gross crumb figure to give what I have called the "true crumb" percentage. Gravel fractions from the plots of the statistical experiments were usually fairly even and did not affect the significance of the results so the second sieving was given up. This question was re-examined in dealing with samples from the Bukalasa Manurial Experiment. (Table 8). This is one of the most uneven blocks we have, and the soil has greatly deteriorated

under constant cultivation. The amounts of gravel and true crumb in the gross crumb figures of Table 8 are given below (Table 10).

TABLE 10.—BUKALASA MANURIAL EXPERIMENT.

% Water-stable particles over $\frac{1}{2}$ mm.

	3 sieves		One sieve	
	Gravel	True crumb	Gravel	True crumb
A. Control	19.8	24.2	20.5	18.3
B. Cotton seed 4 tons..	17.0	26.2	15.9	22.6
C. Green manure	18.0	22.7	18.9	18.2
D. B + C	15.9	26.4	16.2	26.7
Significant Difference ..	None	None	None	None

The differences due to the extraction of gravel are not proportional but there is still no significance.

Owing to the volume of routine work undertaken there was little opportunity for research into the fundamentals of crumb formation. Sticky point determinations have been made on all the samples received but we still have insufficient data for the correlation of sticky point with crumb structure potential. Another attack on the same problem was made by finding the distribution of clay and organic carbon among the soil fractions obtained by wet sieving. Table 9 gives the crumb, mechanical and organic carbon analyses from a composite Kawanda sample.

TABLE 11.—COMPOSITION OF SOME CRUMB FRACTIONS OBTAINED BY WET SIEVING.

Description	Crumb %	Coarse Sand	Fine Sand	Silt	Clay	Carbon
Whole soil ..		37.8	22.8	15.0	26.1	1.70
Over 2 mm ..	42.5	36.7	23.0	10.4	30.8	1.66
2 mm.—1 mm. ..	14.7	37.1	22.3	13.9	28.5	1.64
1 mm.— $\frac{1}{2}$ mm. ..	12.4	44.6	21.7	11.1	26.4	1.48
$\frac{1}{2}$ mm.—100 mesh	23.1	54.7	18.0	6.9	23.4	1.30
100 mesh 200 mesh	2.0	—	77.1	8.4	16.9	1.08
Under 200 mesh ..	5.3	—	43.6	17.0	43.0	2.46

An interesting feature of the table is the steady decline of both clay and carbon as the crumbs get smaller until we reach the finest material, passing a 200 mesh sieve. The clay percentage of the larger crumbs is however higher than the general average for unfractionated soil whereas the crumb carbon figures all are lower. There is therefore a suggestion that carbon is not so intimately concerned with crumb formation as is clay. In the next table the data are rearranged to give the weights of clay and carbon found in fractions obtained by sieving 100 gms. of soil in water.

TABLE 12.—DISTRIBUTION OF CLAY AND CARBON IN GRAMMES.

100 grammes of soil fractionated by sieving in water.

Fraction.	Clay.	Carbon.
Over 2 mm. ...	13.1	0.71
2 mm.—1 mm. ...	4.2	0.24
1 mm.— $\frac{1}{2}$ mm. ...	3.3	0.18
$\frac{1}{2}$ mm.—100 mesh	5.4	0.30
100 mesh—200 mesh	0.3	0.02
Under 200 mesh	2.3	0.13

Should these figures be confirmed after the examination of a large number of samples from field experiments on widely varying soil types we shall be nearer an explanation of the fact that organic manures do not greatly influence soil structure.

The Kigezi Overpopulation Problem.

The overcrowded nature of parts of Kigezi has caused disquiet for some time. At the end of 1944 a committee was formed to study the question and to make recommendations. I was asked to advise on certain aspects of the investigation including "the degree of deterioration that had taken place on plots continuously cultivated, the maximum degree of slope that can be safely cultivated, the optimum width of plots on the various angles of slope; the periods of cultivation and resting under local conditions and suggestions for soil conservation methods in the overpopulated areas". I was also invited to visit any new areas considered for resettlement. The results of the field and laboratory investigations were embodied in memoranda dated March 12th and April 30th, to the Committee but as this is the first time that soil structure data have been used in an investigation of this type the main features of the reports are given here.

The soils of the overcrowded areas of Kigezi are all developed on the phyllites, shales and sandstones of the Karagwe-Ankolean system. Under humid conditions the softer members of this series weather well giving deep soils of good structure through which rain penetrates easily. Although these rocks are metamorphosed lake sediments the soils derived from them in Kigezi are not highly leached. The mean pH of 24 samples from Kyanamira gombolola is 6.7, an indication that the soils are well supplied with bases; the only exceptions are the pale coloured soils derived from the grey and blue shales which are acid and probably less fertile. Steep fluted hillsides and wide U shaped basins are characteristic of the area. In some places the basin is dry and in others is papyrus-choked swamp. The soils of the hill-tops are usually shallow warm brown loams rarely a foot in depth and often contain quantities of unweathered shale or phyllite. The subsoil of the hill-tops consists of comminuted rock fragments often several feet in depth. The soils of the hill slopes are generally deeper particularly in the hollows of the folds and along the foot-slopes. In some places the floor of the arena is dotted with dome-shaped hillocks of deep rich soil and the soil of the floor itself is a heavy grey loam, rather acid (pH=6.4) and intractable in wet weather. Normally the people live at the base of the footslopes, cultivate the hillsides and use the hilltops and the valley floors for grazing. Bare scars of cattle tracks running straight up the spurs of the hills are a feature of the countryside.

To assess the degree of exhaustion of these soils and to estimate the periods of cultivation and rest necessary to restore them it is essential to examine soil samples from plots of known cultivation history. This we found a matter of some difficulty because the peasants and minor chiefs were usually at variance in their information. Thanks however to the patient enquiries of Mr. Lytton a representative series of samples was collected for structure analysis.

Crumb percentages were obtained by both the three sieve bank and by using the $\frac{1}{2}$ mm. sieve only and in each case the gravel and coarse sand figures have been deducted to obtain a true crumb percentage as already described. Sticky points and available nutrients by Spurway's quick test method were also determined. The results of these tests are given in the following tables.

TABLE 13A.—SOILS FROM THE KABALE OVERPOPULATED AREA.

True crumb over $\frac{1}{2}$ mm. using three sieves.

Soil cultivation history	Bukinda Traverse	Kyanamira Kigata	Kyanamira Rwakuna	Bubale	Kitumba Bushuru	Rwama-chuchu Kitozho	Mean
Continuous cultivation	55.7	62.1	61.6	52.6	53.2	59.3	57.4
Cultivated 3 years ..	47.2	74.6	62.5	..	64.3	60.8	61.9
Cultivated 2 years ..	53.0	64.4	57.3	56.0	48.6	65.8	57.5
Cultivated 1 year ..	43.0	..	73.3	52.6	54.7	66.6	58.0
Rest 1 year ..	..	54.7	61.4	59.7	..	60.5	59.1
Rest 2 years ..	44.4	..	79.0	58.6	67.4	..	62.3
Rest 3 years ..	..	73.3	73.0	39.9	57.4	75.0	63.7
Not cultivated ..	..	..	..	..	..	..	..
Upland grazing ..	53.0	66.0	83.8	79.3	58.5	68.8	68.2
Not cultivated ..	..	..	..	..	..	..	..
Lowland grazing ..	82.1	78.6	79.6	..	..	..	80.1

TABLE 13B.—SOILS FROM THE KABALE OVERPOPULATED AREA.

True crumb over $\frac{1}{2}$ mm. using one sieve only.

Soil cultivation history	Bukinda Traverse	Kyanamira Kigata	Kyanamira Rwakuna	Bubale	Kitumba Bushuru	Rwama-chuchu Kitozho	Mean
Continuous cultivation	47.1	58.7	51.0	51.3	43.0	49.5	50.1
Cultivated 3 years ..	39.7	65.3	61.3	..	60.0	48.9	55.0
Cultivated 2 years ..	47.2	61.9	52.8	52.8	40.0	55.7	51.7
Cultivated 1 year ..	43.1	..	66.9	40.6	49.2	57.2	51.4
Rest 1 year ..	..	51.3	52.3	39.6	..	53.5	49.2
Rest 2 year ..	40.2	..	74.6	53.6	64.4	..	58.2
Rest 3 year ..	..	51.7	66.7	33.2	48.6	66.7	53.4
Not cultivated ..	..	..	..	..	..	..	..
Upland grazing ..	53.4	67.9	78.1	83.7	56.9	64.6	67.4
Lowland grazing ..	68.5	71.7	82.4	..	..	..	74.2

TABLE 13C.—SOILS FROM THE KABALE OVERPOPULATED AREA.

Sticky points—crumb structure potential.

Soil cultivation history	Bukinda Traverse	Kyanamira Kigata	Kyanamira Rwakuna	Bubale	Kitumba Bushuru	Rwama-chuchu Kitozho	Mean
Continuous cultivation	26.2	39.3	42.4	29.3	32.5	36.1	34.3
Cultivated 3 years ..	26.3	39.7	43.2	..	32.5	32.7	34.9
Cultivated 2 years ..	29.8	44.6	36.4	27.7	27.4	38.4	34.1
Cultivated 1 year ..	24.6	..	42.2	29.9	23.9	34.6	32.0
Rest 1 year ..	..	47.5	37.6	28.8	..	36.1	37.5
Rest 2 years ..	31.0	..	41.1	27.5	32.8	..	33.1
Rest 3 years ..	..	37.2	36.7	25.1	32.2	37.1	33.7
Not cultivated ..	..	..	..	..	..	..	..
Upland grazing ..	33.1	58.7	37.5	46.9	53.1	33.0	43.7
Lowland grazing ..	56.8	43.4	56.3	..	..	..	52.2

TABLE 13D.—SOILS FROM THE KABALE OVERPOPULATED AREA. AVAILABLE NUTRIENTS. SCALE 0-5. T = TRACE.

	Continuous cultivation	Cultivated 3 years	Cultivated 2 years	Cultivated 1 year	Rest 1 year	Rest 2 years	Rest 3 years	Not cultivated	Upland grazing	Not cultivated	Lowland grazing	Means
Bukinda:												
pH	6.4	6.4	4.6	5.1	..	4.7	..	..	4.8	..	5.4	5.3
P ₂ O ₅	3	1	T	T	..	T	..	..	T	..	T	1
K ₂ O	2	T	0	T	..	T	..	..	T	..	1	2
CaO	3	2	1	1	..	1	..	..	1	..	2	2
N ₂	4	3	1	0	..	0	..	..	0	..	2	1
Kyanamira Kigata:												
pH	6.6	6.5	5.2	..	5.0	..	6.5	..	5.0	..	5.2	5.7
P ₂ O ₅	3	1	T	..	T	..	1	..	T	..	0	1
K ₂ O	2	2	1	..	T	..	3	..	T	..	2	1
CaO	3	2	4	..	1	..	2	..	1	..	1	2
N ₂	3	3	2	..	1	..	5	..	0	..	0	2
Kyanamira Rwakuna:												
pH	6.5	6.5	5.8	6.3	6.3	6.7	6.3	..	6.3	..	6.3	6.3
P ₂ O ₅	2	T	T	T	T	T	1	..	2	..	2	1
K ₂ O	2	1	2	2	1	1	3	..	4	..	3	3
CaO	3	3	1	3	2	3	1	..	2	..	3	3
N ₂	2	2	1	2	5	3	2	..	0	..	0	2
Bubale Mile 3:												
pH	6.7	..	6.2	6.0	6.2	6.1	5.5	..	6.2	..	..	6.1
P ₂ O ₅	1	..	0	T	0	0	0	..	1	..	..	T
K ₂ O	3	..	1	1	1	T	1	..	1	..	..	1
CaO	4	..	2	3	2	1	1	..	3	..	..	2
N ₂	4	..	4	5	1	T	T	..	T	..	..	2
Kitumba Bushuru:												
pH	6.2	6.2	6.0	6.2	..	6.3	6.2	..	5.9	..	..	6.1
P ₂ O ₅	0	0	0	1	..	0	0	..	T	..	..	T
K ₂ O	2	2	2	2	..	3	1	..	3	..	..	2
CaO	4	3	2	2	..	3	2	..	2	..	..	3
N ₂	3	4	1	4	..	T	2	..	T	..	..	2
Rwanamachuchu Kitozho:												
pH	6.2	6.6	6.6	5.3	5.7	..	6.5	..	6.0	..	..	6.1
P ₂ O ₅	1	3	2	1	0	..	5	..	2	..	..	2
K ₂ O	1	4	3	3	2	..	4	..	4	..	..	3
CaO	3	2	3	3	T	..	T	..	3	..	..	2
N ₂	4	0	3	3	T	..	T	..	1	..	..	2

The first fact which emerges is the high crumb figure obtained on all the Kabale soils, even those which have been cultivated for many years. The average crumb percentage recorded from Buganda soils of excellent structure is little over 60% and the lighter soils of the Eastern Province rarely give 50% of crumbs. Here therefore is the probable explanation of the extreme permeability and resistance to erosion of the soils on the steep slopes of the Kabale region.

Having in view the extreme difficulty of obtaining accurate plot cultivation history it is probable that the only really sound information relates to those areas which have always been used for grazing. Those give mean figures of 68.2 for uplands and 80.1 for lowlands (3 sieves). If these may be taken as optimum crumb percentages then it is clear that there has been soil deterioration through cultivation. The other figures show no significant differences between the periods of cultivation and rest. This may be due in part to the fact that the resting cover is rarely grass and partly to the probability that the soil histories recorded are not accurate. I would suggest therefore that some grass resting-cover experiments should be carried out on one of the overcrowded areas before attempting to fix a rotation. If however an interim rotation is urgently needed I can only suggest two years of cultivation followed by one of rest, *under grass* as being likely to improve the soil, not unlike the period of the present weed rotation, and therefore the more readily accepted by the people.

In the main, the crumb percentages obtained by the use of a single sieve are consistently lower than the three sieve figure. It seems probable therefore that this extremely rapid and simple method of wet sieving will be a reliable tool for the assessment of the structural condition of any soil.

The sticky point values are not so consistent but here again the samples drawn from uncultivated lands give much higher results than the truly arable lands. The sticky points of Kawanda and Bukalasa soils are normally under 30 and their structure potential is 60 or over. If therefore the sticky point may be taken as a guide, the structure potential of these Kabale soils should be well over 60.

The mineral nutrient values in Table 13D are included for comparison with the results obtained by the examination of soil samples from some of the possible resettlement areas. The figures, which are estimated on a 0-5 scale do not pretend to be accurate and are only useful for rough comparisons.

RESETTLEMENT AREAS.

Ruzumbura.—The soils of the area north of Rukungiri are brown to brownish black sandy loams overlying a light brown gritty subsoil. They are rarely very deep and have a quartz gravel streak at 7" to 18" from the surface. There is a noticeable improvement in soil colour and body between Nakageme and Kichwamba. These soils are not as deep and are more acid than those of the Kabale area but they are said to have produced very good crops before the people were driven out by pig and buffalo. The mean sticky point value is of the same order as that of the cultivated soils of Kabale. The laboratory data are shown in Table 14.

Ruampara.—Although this area is typical Karagwe-Ankolean in topography, the rocks are mainly the sandstone and quartzite members of that series. The effective rainfall must be much lower than in Kigezi with the result that the soils of the ridges are not deeply developed. The subsoils are composed mainly of loose gravels. At first sight one would say that this area is quite unsuitable for agricultural development by the Bakiga but we found outstanding plots of plantains and coffee (both heavily mulched). The hollows of the hills and the valley bottoms are all tree covered and have been

TABLE 14.—SOILS FROM RUZUMBURA COUNTY, KIGEZI. CRUMB STRUCTURE AND AVAILABLE NUTRIENTS.

Place	Soil description	Sticky point	Crumb structure 3 sieves $\frac{1}{8}$ mm.	pH	Available nutrients			N ₀
					P ₂ O ₅	K ₂ O	CaO	
Kabwona	Valley bottom—not cultivated for six years	32.1	46.8	5.7	1	1	1	0
Rugando	Deep soil on ridge—not cultivated for many years	44.9	42.4	7.5	4	4	5	3
"	Black soil 13" deep	40.6	48.4	6.1	2	T	1	T
"	Light brown sub-soil under preceding sample	29.4	51.1	5.9	0	0	T	1
Munyaganyeye	Dark soil good structure—not cultivated	22.1	66.8	5.4	1	T	2	1
"	Same site cultivated three years	33.6	25.6	5.9	1	3	1	0
"	Same site rested three years after cultivation	30.0	41.9	5.7	T	T	1	T
Bugangare	Not cultivated since 1929. Top soil 12"	43.3	40.7	6.5	3	3	3	2
"	Not cultivated since 1929, bottom of ridge	35.2	57.8	6.1	1	3	2	1
"	Same ridge, 14" dark grey loam on quartz gravel	48.3	67.8	6.0	3	4	3	0
"	Same ridge, 9" poorer top soil	24.5	41.2	5.8	1	T	1	0
KICHWAMBA—								
Rutabago	Dark loam under <i>Imperata</i>	43.3	63.0	6.2	2	1	1	1
Nzororo	Dark loam under <i>Themeda triandra</i>	37.9	70.6	5.7	0	2	1	1
Mean	"	35.8	51.1	6.0	1	2	2	1

demarkated Crown Forest Reserves. It would appear that the only way in which this area could be prepared for some distant future resettlement would be by gradually extending the forests up the slopes and along the ridges by active afforestation so that eventually the valuable agricultural land in the valleys and hollows could be opened up without detriment to tree cover and climate. Laboratory data from these soils are given in Table 15. It will be noted that the sticky points are more of the order of the uncultivated Kabale soils.

Buhwezhu.—The road from Bwizibwera through Nsika to Nyakashaka runs through typical Karagwe-Ankolean country with the same phyllites and shales as are found around Kabale. Judging from the vegetation the effective rainfall increases as one approaches Nyakashaka where woodland and bracken predominate. Unfortunately the slopes are steeper and the valleys more V-shaped than those in Kigezi but the soils are very like those the Bakiga are working in their own homes. It is a fact that the most successful agricultural immigrants into North America from Europe during the past fifty years are those who have settled on soil types akin to those they worked at home.

Igara.—The country along the line Nyabubale-Kyamuhunga to Lubare is more gently rolling than the Buhwezhu area just described. The trees and grasses indicate good rainfall and the soils, which are developed on granite, range from brown sandy loams to bright red loams. The crops are said to be good and the whole area is worth further investigation as it would link up with the Buhwezhu country right on to the Toro border. The laboratory data from the samples taken in these areas are given in Table 16. It will be seen that although soil structure and sticky point seem to indicate a reasonable soil, it is a leached acid soil. It is possible that the nutrient status would be improved by cultivation but a more detailed survey would not be justified unless a mass resettlement scheme is found necessary.

SOIL CONSERVATION IN THE OVERCROWDED AREA.

It is clear that in the past there has been a good attempt to establish contour lines of trash or elephant grass but from various causes there are too many gaps. The cultivators say that these gaps have been made to get rid of vermin and couch (*Digitaria scalarum*). This may be only too true but it should have been an easy matter to replant after the pest had been removed; now the hillsides resemble a patchwork of plots of all sorts of sizes with discontinuous contour lines and with furrows up and down the slope as plot boundaries. The erodibility of a plot depends on the soil type, the degree of exhaustion of the soil, the slope and the intensity of rainfall. The result of these forces can be observed only in the field. In the Kabale area the soils are very permeable to water and the rainfall intensity is low so that very steep plots can be cultivated without much danger. I examined many plots, on a 20° slope which showed no signs of erosion in the first 12 or 15 yards of their width.

It had been suggested that contour lines should be established at each 6' vertical drop. Such a course would require a large staff trained to use road tracers or line levels and plots would vary in width continuously according to the angle of slope. It would be easier and much quicker to mark out base contours and from these measure standard plot widths. The base contours could be marked by a team of trained instructors and the subsequent parallel strip lines could be measured by chiefs. Double slopes need extra contour lines.

I think that from 6° to 15° slopes the plot width could be 16 yards, and from 15° to 20° plots 12 yards wide would be safe. Slopes more than 20° should not be cultivated. If, in some areas, the complete retirement of land over 20° may be thought to cause undue hardship, before redistribution

TABLE 15.—THE SOILS OF RUAMPARA COUNTY, ANKOLE. CRUMB STRUCTURE AND AVAILABLE NUTRIENTS.

Place	Soil description	Sticky point	Crumb structure $\frac{1}{2}$ mm.	pH	Available nutrients			N ₂ O ₅
					P ₂ O ₅	K ₂ O	CaO	
Kyonyo ..	Thick grass cover in forest reserve. Dark soil 15" ..	35.6	75.9	8.9	4	3	3	0
Mukenkaranga ..	6" of good structure on light floury subsoil ..	44.4	68.1	5.2	T	0	1	T
Mwisi ..	Cultivated 1½ years after 2½-3 years under hyparrhenia ..	45.2	66.8	6.3	1	3	3	4
Mwisi ..	In thick stand of hyparrhenia ..	50.3	79.6	6.0	2	0	3	0
Kabakarange ..	Cultivated 2 crops after hyparrhenia ..	40.9	70.4	5.6	T	T	2	3
" ..	8 years under hyparrhenia ..	46.4	80.9	5.8	2	2	2	0
Lwenyaga ..	Top soil of good structure on red floury subsoil ..	40.7	71.0	5.5	1	3	1	0
Ntungu ..	Excellent coffee plot mulched on thin soil ..	38.9	69.2	7.2	4	4	4	3
Means ..	" ..	42.8	72.7	6.1	2	2	2	1

TABLE 16.—THE SOILS OF BUHWEZU AND IGARA, ANKOLE DISTRICT. CRUMB STRUCTURE AND AVAILABLE NUTRIENTS.

Place	Soil description	Sticky point	Crumb structure $\frac{1}{2}$ mm. over three sieves	pH	Available nutrients			N ₂ O ₅
					P ₂ O ₅	K ₂ O	CaO	
Naika ..	Composite 9" sample under bracken	59.5	61.8	4.2	T	T	0	0
Kanyamugeze ..	0-9" profile of red soil developed on K.A.	61.7	75.2	4.3	T	T	0	0
" ..	9"-2' Bright red subsoil ..	44.4	55.7	4.5	T	T	0	0
" ..	Below 2' K.A. gravel ..	38.3	27.3	4.4	O	T	0	T
" ..	0-9" profile of brown soil good structure	62.5	63.8	4.3	T	3	0	0
" ..	9"-16" Light brown few roots ..	47.5	66.9	4.2	T	T	0	0
" ..	16"-24" Pale brown no roots ..	36.1	61.4	4.4	T	T	0	0
Nabubale ..	9" of grey gritty soil on coarse angular gravel..	33.0	62.3	6.3	3	2	3	T
Kyakamba ..	0-7" Dark-coloured fine sandy loam ..	41.4	69.7	5.3	T	T	1	0
(Gomb: Kyamuhunga)	7"-15" Dark brown—compact ..	36.9	65.7	4.6	O	T	1	1
Mean ..	" ..	46.1	61.0	4.7	T	1	1	0

of population is effected, the 12 yards plot can be retained with the proviso that plots may not be cultivated for more than two years followed by at least four years of rest under grazed pasture.

Base contours and, if possible, strip lines should be permanently marked by planting *Ficus* or *Erythrina* stumps say every forty yards; later, fill in at will with whatever suitable material is available.

I doubt if slopes under 6° need special conservation measures in Kigezi but if desired for administrative clarity the 16 yards plot could be retained. Slopes of more than 20° could be used for grazing or tree lots provided that some grass cover can be found to subsist under wattle.

Once the strips are established it should not be difficult to develop true field strip cropping in which each strip is under one phase of the rotation. Strips could be planted communally or the plot boundaries marked by lines of a special crop such as maize and not by furrows. Sweet potatoes should be planted on contour ridges.

The Use of Cattle.—At present in Kigezi, cattle are not used in soil regeneration. In Lango and in the Eastern Province it has been found possible rapidly to establish a grass cover by grazing the stubble of the last crop of the rotation. Two striking instances of the same effect were noted in Kigezi and it is suggested that an attempt should be made to graze the resting land more generally. At the same time the present permanent pastures of the bottom lands should be brought into arable rotation.

Ankole type cattle do not do as well as the local hornless type which is a useful little animal and a good "doer". Could not this type be increased and popularised as general utility animals? I see no reason why ploughing should not be introduced once contour strip cropping is firmly established and the more animals there are on the land the better it will be for the soil and the people.

In his traverses Mr. Purseglove has found that where cattle tracks are hedged, erosion is greatly reduced by the grass that grows through the rows. This clearly suggests that a native law should make these hedges compulsory.

Trees.—It has already been noted that the people prefer to live on the fertile footslopes and grow their trees (wattle) around their houses. This is a waste of good agricultural land as firewood lots could be established on steeper slopes which are not safe for arable operations. At the same time erosion under wattle is often severe and experiments should be carried out to find a suitable ground cover for wattle plantations.

Enquiries have been made in the past as to the possibility of establishing a wattle bark industry in Kigezi. The conclusion reached was, I believe, that such an industry could not carry the inevitable transport costs. But village tanning industry could be started to make use of the extra bark produced by the strip plantings and a steady internal market would be certain in a skin clothed tribe.

Swamp Drainage.—Mention has already been made of the papyrus swamps of Kigezi. During the drought of 1943 extensive swamp drainage schemes were initiated and swamp fringes were also used for sweet potato planting. In an earlier report I pointed out that the potential fertility of swamps was in direct proportion to the reserve of organic matter present and that papyrus swamps were usually superior to others in this respect. At the same time I advised caution in the matter of swamp reclamation because of the absence of hydrological data and suggested the installation of markers, with a view to obtaining some preliminary information.

During the present tour I inspected the swamp at Kasambya which was drained two years ago. This land is producing excellent crops including the best pasture I have seen in Uganda but the general land level appeared to

have dropped over 10 ft. in two years. I suggest that this swamp should be subject to detailed observations on the effect of drainage.

Observations in Kigezi have brought out the fact that the swamp fringe plantings provide breeding places for a malaria vector (*Anopheles christii*) whereas this insect does not breed at Kasambya. Thus it appears that swamps must be drained scientifically or not at all and that the whole question of swamp reclamation even in these congested areas must await the study of a competent hydrologist.*

Social Welfare.—One contributing factor to the congestion in certain areas is the desire of the people to settle in the immediate neighbourhood of their administrative capitals, sazas and even gombololas. The people are becoming urbanised. The classic instance of course is the Kabale area itself but it was noticeable around Nsika. In the now very sparsely inhabited area of Ruampara there was once a saza headquarters and the people moved where the saza moved. It is clear therefore that the consolidation of administrative units is actually aggravating the congestion and causing a very uneven pressure distribution on the land. It may be said that this is a natural process which has taken place in all agricultural communities with the advance of education, but it is happening in Uganda fifty or a hundred years before it might have been expected.

The tendency in Uganda could be checked by increasing the number of gombololas and even sazas and by the establishment at each gombolola headquarters of:—

- (a) dispensary;
- (b) school;
- (c) village industries;
- (d) N.A. shop.

Kigezi is an unspoilt compact district which could be used as a whole for an experiment along these lines before embarking on big scale resettlement outside its borders.

General.

Empire Cotton Growing Corporation.—The search for a suitable site for a Central Research Station was continued both by Corporation and Departmental Officers. At the suggestion of the Director of Agriculture a reconnaissance survey of areas in Budama and Bugwere near Tororo Township was made with the Senior Botanist. Although one or two areas were marked for detailed survey if occasion arose our conclusion was that no suitable site could be found in that area.

The writer made a rapid survey of the Namulonge site in October. Later Messrs. Parnell and Hutchinson surveyed the site in much greater detail and decided that a research station could be established there.

Swamp Reclamation.—At the end of the period under review, Mr. Griffin, M.I.C.E., arrived from England to advise on this question. I was entrusted with the duty of outlining the problem as we saw it, of arranging contacts with officers of other interested departments and arranging itineraries to include the major swamps, drained and undrained. Mr. Griffin has since indicated the lines of preliminary investigation needed to obtain data prior to a further study of the problem by a hydrologist working with a meteorologist

Routine analyses of nicotine tobacco, oils and crop moistures have revealed no points of general interest.

*Since the above paragraph was written Mr. Griffin has visited the area. He has re-iterated the need of a hydrological study of the country. He has also recommended a controlled experiment in reclamation in the Kasambya swamp.

Compost.—The Kampala Township compost factory turned out 1,740 tons of good manure which has been distributed by the Agricultural Department to assist in the regeneration of the badly overcrowded areas around the township. Modifications of the method have been made by Mr. Hodson and his staff to overcome difficulties as they arose. A light dressing of Bugishu phosphate is also being sprinkled on each layer of refuse during the building of the stacks and a compost of excellent quality results.

Future Work.—In all the past work of this section, great emphasis has been laid on the need for complete and easy penetration of rainfall both for the crop and for soil conservation. The maintenance of soil fertility is therefore closely bound up with the maintenance of a good soil structure, if indeed these terms are not synonymous. If we have shed some of our youthful faith in the magic symbols N.P.K. and have not been induced to join the rush in laying out multi-factor experiments it was not that we considered these things unimportant but that they were of less immediate urgency in a land of peasant farmers, 800 miles haul from the Coast. The first essential was soil conservation and a simple practical agricultural system whereby the soil may be preserved in good heart *in situ*. A beginning towards attaining this ideal has been made in the adoption of the grass rotation for arable, and contour mulching for permanent and semi-permanent crops. Much remains to be done particularly in elephant grass—couch areas but the time has come to examine the nutrient position more carefully.

Attention has already been drawn⁽¹⁾ to the enormous drain of mineral nutrients involved in the export of cotton seed. The position may be eased by the discovery and use of the Bugishu phosphate deposits and by the possibility of cheap nitrogen after the war. Trials are therefore planned in which Bugishu phosphates are used with and without added nitrogen. More detailed N.P.K. experiments are also planned to be carried out as soon as the staff position is normal. In addition strip trials of Bugishu phosphates are to be made in overcrowded areas and on poor grasslands.

Refined cotton seed oil has, during the war, found a ready market which seems likely to remain steady in peace time. The trials with cotton seed and its bye-products as fertilizers will therefore be continued.

(1) Annual Report, Department of Agriculture, Uganda, 1936, Part II, page 51.

W. S. MARTIN,
Senior Chemist.

ANNUAL REPORT OF THE AGRICULTURAL ENTOMOLOGIST.

Staff.

Mr. Hargreaves was in England on retiring leave. Dr. Taylor left Uganda in July on secondment to the Imperial Institute of Entomology, London. Mr. Stephenson was absent from Uganda on secondment to the East African Anti-locust Directorate. Mr. Wilkinson, Senior Entomologist, Kenya, took over from Dr. Taylor and acted as Senior Agricultural Entomologist until August. He then returned to Kenya. Mr. Kevan, Entomologist, Kenya, took over from Mr. Wilkinson and acted as Agricultural Entomologist until September when he returned to Kenya. Mr. Darling arrived in Uganda on appointment as Agricultural Entomologist on August 31st. Mr. Mubbiru was on duty throughout the year except for 17 days' leave taken in January.

At no time during the year has more than one European Entomologist been on duty. Staff shortages and changes have adversely affected the activities of the section, and little research work has been attempted.

Mr. Mubbiru carried out routine surveys of cotton pests at Serere from July to October. Since then he has been on duty at Kawanda. Mr. Darling made several safaris including one in the Western Province in December, and one in Karamoja and Turkana in June; otherwise he was at Kawanda.

LOCUSTS.

(a) *Desert Locust (Schistocerca gregaria Forsk.)*

During July, August, and September activity was confined to Karamoja. A few mature swarms were present and egg-laying occurred in August. Hatching followed and hopper bands totalling some 10 square miles in area were reported in early September. The main centres of hopper activity were Loyoro (latitude $3^{\circ} 15'$ North, longitude $34^{\circ} 25'$ East) and Nakiloro ($2^{\circ} 35' N.$, $34^{\circ} 45' E.$). Control measures using poison bait were carried out by local labour under the direction of Mr. P. van Rensburg, a locust scout appointed by the East African Anti-Locust Directorate. The majority of the hoppers were destroyed, but sufficient escaped to form one swarm which was reported in flight by September 30th.

This immature swarm with others from Turkana (north-west Kenya) flew westwards across north-east Uganda during October invading Acholi, Lango and Teso districts. This westward migration was temporarily checked in late October, apparently by heavy rain in Acholi and Lango, but was resumed in November the swarms reaching Pabbo ($3^{\circ} N.$, $32^{\circ} 10' E.$) and Kibiye ($1^{\circ} 55' N.$, $32^{\circ} 20' E.$). By the beginning of December the swarms had become mature, and during this month they ranged over northern and north-eastern Uganda, decreasing in size and gradually dying out. A small mature swarm was reported in West Nile in Kobboko county ($3^{\circ} 30' N.$, $31^{\circ} E.$). Egg-laying occurred in Karamoja near Luwapit ($3^{\circ} 15' N.$, $34^{\circ} 25' E.$).

During January no swarms were reported in Uganda, but the eggs laid near Luwapit hatched to give hoppers which were subsequently destroyed by local labour under Mr. van Rensburg.

During February several small immature swarms invaded Uganda from north-west Kenya and by the end of the month had crossed the north half of the protectorate from east to west. Karamoja, Teso, Lango, Acholi and West Nile districts were affected. During March these swarms continued to move uncertainly over northern Uganda.

In late March several immature swarms invaded south-west Uganda from Ruanda (Belgian Congo) passing north and south of the Muhavura-Mgahinga range of the Bufumbira mountains. During April, these swarms moved north through western Uganda and north-eastern Belgian Congo,

maturing as they went. On April 22nd, a large mature swarm was reported in West Nile near the Belgian Congo border (2° 55' N., 30° 50' E.). It is thought that these swarms subsequently reached the Anglo-Egyptian Sudan where a large mature swarm was reported from Juba on April 30th. This invasion of south-west Uganda parallels that of March-April, 1929, when swarms from Tanganyika passed round southern Lake Victoria, through Ruanda-Urundi, and into Ankole and Kigezi.

During April and May the swarms in north and north-east Uganda gradually matured and retreated into Karamoja where eggs were laid in the Suk area in late May (2° N., 35° E.).

In June, swarms were absent from Uganda but the eggs in Suk yielded several large bands of hoppers which were destroyed by operations carried out by Mr. van Rensburg.

Crop damage by adult swarms was reported during the year from Teso, Lango, Acholi, Ankole, Kigezi and Toro districts. This was sometimes severe locally. Crops attacked included cotton, sorghum, sweet potatoes, cassava, field beans, cowpeas, pigeon peas and sesame.

Throughout the year fortnightly reports have been compiled from the routine reports supplied by the field and district officers of the department and of the Administration. These fortnightly reports have been sent to the Anti-Locust Research Centre, London, and this centre has supplied monthly locust forecasts which have proved accurate and have been of considerable value.

(b) *Red Locust (Nomadacris septemfasciata* Serv.).

This locust has been active in Tanganyika but no swarms have yet reached Uganda.

(c) *Tropical Migratory Locust (Locusta migratoria migratorioides* R. & F.).
No activity reported.

COTTON PESTS.

(a) *Serere (Eastern Province).*

Observations were made by Mr. Mubbiru from June to November, 1944. The attack by *Lygus* spp. (Capsidae) followed its normal course and was of average severity. The migration to cotton from sorghum and eleusine took place in June, 1944, when the latter crops were harvested. Populations on cotton reached a peak in August and then declined. By October only a few scattered adults were to be found.

Infestation by stainers (*Dysdercus* spp., Pyrrhocoridae) began in early July when adults of *nigrofasciatus* Stal. and *superstitiosus* Sign. migrated to the plants. *D. cardinalis* Gerst., normally present in small numbers, was not observed at all. By the end of October populations were still at a low level, but prolonged second rains which lasted well into December caused a heavy infestation to develop at the end of the season.

Jassid attack was moderately severe on glabrous varieties. *Helopeltis* (Capsidae) attack was insignificant.

Of the cotton boll worms, *Argyroplote leucotreta* Meyr. (Eucosmidae) caused the most damage, the attack on early cotton beginning in August. *Platyedra gossypiella* Saund (Gelechiidae) was not observed on cotton until October, and its attack was never serious. A few *Earias* spp. (Noctuidae) were observed in June but no appreciable damage was done.

(b) *Kawanda (Buganda).*

No detailed observations on *Lygus* spp. were made. The attack on cotton growing alongside sorghum was not noticeably different from that on cotton growing at a distance. Fresh *Lygus* damage on late new cotton growth was noticed by the Senior Botanist in early December and a few adults were caught by sweeping. *Lygus* is not normally present on Kawanda cotton in December and this incidence was probably due to abnormal conditions caused by the prolonged second rains.

Observations were begun on stainers (*Dysdercus* spp.) in late November. A count made on 30th November on 33 plants of April sown cotton (Block II, strip 1) selected at random, indicated a population of about 30,000 adult stainers per acre. They were dominantly (98%) *D. fasciatus* Sign. with a few (2%) *D. nigrofasciatus*. Immediately after this count the cotton on this strip was uprooted and burnt.

Further stainer counts were made at fortnightly intervals from December 4th to February 12th (all Kawanda cotton was uprooted and burnt by February 19th) on other April sown cotton (Block VIII, strip 4 and Block X, strip 6) and on a July sowing (Block IX, strip 4). These counts were made by selecting 25 plants at random along a diagonal of each strip and counting carefully all adult stainers on each plant. Nymphs were not counted. The results are tabulated below.

	Date of count	Population of different species of <i>Dysdercus</i> on 25 plants			Total on 25 plants	Population per acre
		fasciatus	nigro-fasciatus	superstitiosus		
Block X	4-12-44	2	38	..	40	16,000
Strip 6	18-12-44	2	11	..	13	5,200
Sown	8-1-45	2	6	2	10	4,000
14 and 15/4/45	15-1-45	5	11	..	16	6,400
	29-1-45	17	10	1	28	11,200
	12-2-45	8	5	..	13	5,200
Block VIII	4-12-44	1	2	..	3	1,200
Strip 4	18-12-44	..	..	..	..	..
Sown	2-1-45	..	3	1	4	1,600
27/4/45	15-1-45	..	3	..	3	1,200
	29-1-45	8	17	1	26	10,400
	12-2-45	21	7	..	28	11,200
Block IX	4-12-44	1	5	..	6	2,400
Strip 4	18-12-44	..	14	..	14	5,600
Sown	2-1-45	4	12	..	16	6,400
12/7/45	15-1-45	9	11	..	20	8,000
	29-1-45	45	31	2	78	31,200
	12-2-45	28	13	..	41	16,400

From these results, which should be regarded with caution owing to the small number of plants counted per strip, the following points emerge:—

(1) During December, January and February the indicated populations of *Dysdercus* spp. averaged about 8,000 adults per acre. These were dominantly *fasciatus* and *nigrofasciatus* with a few (less than 5%) *superstitiosus*.

(2) The indicated populations rose from about 5,000 adults per acre in December to an average of over 14,000 adults per acre in late January—early February.

(3) This rise was mainly due to an increase in the incidence of *fasciatus*. During December this species averaged 8%, during January 45% and during February 70% of the indicated adult populations.

No previous records of stainer populations on cotton at Kawanda are available. Counts made at Serere in December, 1935, indicated a population of 3,000 adults per acre. This was apparently regarded as large for Uganda. It would therefore appear that the 1944-45 infestation has been unusually heavy. It is of interest to note that in "*Agriculture in Uganda*" (J. D. Tothill, 1940, Oxford University Press, London) in the section on cotton-stainers by Gwynn, Hargreaves and Taylor, the authors state "The size of the population which develops in the second rains clearly depends on, firstly,

the number of stainers which spread to cotton initially, secondly, the duration of the rainy period, and thirdly, the frequency of rain in that period. Very dry weather would cause a relatively large initial invasion, and an unusually prolonged wet season with frequent rain after the dry weather would make possible abnormally extensive multiplication". The climatic conditions postulated above were largely fulfilled in 1944 and the prophecy of "abnormally extensive multiplication" was also fulfilled.

In late December a survey was made of boll damage, 7,500 bolls from discard rows of the variety trial on Block IV, strip 2 being examined individually. A total of 3,702 bolls, or 49%, showed damage, the responsibility for which was as follows:—

<i>Argyroploce leucoireta</i>	...	1.3%
<i>Platyedra gossypiella</i>	...	1.2%
<i>Earias</i> spp.	...	0.5%
<i>Dysdercus</i> spp.	...	46.0%
		49.0%

I wish to acknowledge with thanks the assistance of Mr. J. D. Jameson, Senior Botanist, in connection with the work on cotton pests.

PESTS OF COFFEE.

In December a limited examination was made of *Antestia* populations on coffee in Mubende, Toro, and Ankole districts. At Kakumiro, populations of 25–30 bugs per tree (including nymphs) were found on "nganda" coffee (*C. canephora*) growing near to *arabica* trees which had recently been stripped of their crop. The "nganda" was still carrying many berries. The populations were mixed consisting of 60% *A. lineaticollis* Stal. and 40% *A. faceta* Germ.

Laboratory examination of small samples of material collected in Mubende, Toro and Ankole failed to show any nymphal or adult parasites, but up to 100% parasitism of eggs by *Microphanurus* spp. were observed.

PESTS OF FOOD CROPS.

(a) Bananas.

In 1934 and 1935 introductions were made from Java to Uganda of *Plaesus javanus* Fr. (Histeridae)⁽¹⁾. This predacious beetle is reported to control the Banana weevil, *Cosmopolites sordidus* Germ, in parts of the Dutch East Indies. It was hoped that it might similarly control this pest in Uganda. Several liberations of the pest were made on Kibibi Island, Lake Victoria, among banana plants which were heavily infested with weevils. Kibibi was not revisited until September, 1944, when a search was made to recover the predator. No trace of it could be found and the weevil population was observed to be large. There is therefore no evidence that the introductions have been successful.

(b) Cassava.

At the request of the Senior Botanist, fortnightly observations are being made at Serere and Kawanda on the incidence of nymphal and pupal scales of *Bemisia* spp. (Aleyrodidae) on cassava. This white fly is the vector of cassava Mosaic disease.

(c) Sweet Potato.

Severe damage was caused at Kawanda in December, January and February by *Acraea acerata* Hew. (Nymphalidae). Some plots were entirely defoliated by the caterpillars of this butterfly. Attacks by this pest appear to have been general throughout much of southern and western Uganda, and to have been severe locally.

(1) See Annual Reports of Government Entomologist, 1934 and 1936.

At the request of the Plant Pathologist and of the Senior Botanist, fortnightly observations are being made on the incidence of nymphal and pupal scales of *Bemisia* sp. on sweet potato vines at Kawanda.

(d) *Finger Millet (Eleusine).*

Brairding eleusine in north-west Ankole was severely attacked in October by Acridid grasshoppers. These included *Humbe tenuicornis* Schaum., *Oedaleus* sp., *Acrotylus* sp., *Paracomacris* sp., *Sumba* sp., *Roduniella* sp., and *Catantops melanostichus* Schaum.

(e) *Beans.*

Considerable damage was done to "mutike" (*Phaseolus lunatus*) and tepary (*P. acutifolius*) beans in Busoga in May by beetles. These included *Lagria villosa* Fab. (*Lagriidae*), *Coryna apicornis* Guer. (*Meloidae*) and *Ootheca bennigseni* Wse. and *O. bifrons* Laboiss (*Galerucidae*).

Bean crops in Kigezi were also damaged in May by beetles. *Gonocephalum simplex* F. (*Tenebrionidae*), which is occasionally a pest of cotton and coffee, attacked seedlings when they were two to four inches high. *Haltica* sp. (*Halticidae*) attacked leaves and flowers. The damage was not serious

OTHER CROPS.

(a) *Pyrethrum.*

Pyrethrum plants in Kigezi were found to be attacked at the roots by larvae of Lamellicorn beetles (?*Cetoniidae*). Plants of all ages were attacked, but grubs were most easily found in the younger stands, where their incidence was sporadic. There was usually only one grub per plant, and attacked plants looked weak and unhealthy. Hand-picking was recommended as a control measure.

Old plants on the same estate were found to be harbouring large numbers of wood-lice (*Crustacea*, *Isopoda*) and millipedes (*Julidae*). These were not believed to be harmful but were thought to be feeding on the dead and decaying plant material which formed a central core in each of these old plants.

(b) *Tobacco.*

High nicotine content tobacco plants in Kigezi were slightly damaged in November and December by caterpillars of *Phytometra orichalcea* Fabr. (*Noctuidae*). This moth is known as a pest of flax in Kenya, but so far has not been reported on this crop in Kigezi.

(c) *Castor Oil.*

A plot of this crop at Kawanda was heavily attacked in January by *Pryelus grossus* Fab. (*Cercopidae*). Nymphs and adults of this large Cuckoo-spit were very numerous and their attack caused defoliation of some of the plants.

(d) *Eucalyptus.*

Specimens of the Eucalyptus Weevil, *Goniapterus scutellatus* Gyll. (*Curculionidae*) were collected in Mbale district in January by a member of the Forestry Department. Apparently the pest had been present there since 1942 and had defoliated older trees of *Eucalyptus robusta*. Young trees were only slightly attacked. This weevil, a native of Australia, was reported as a pest in South Africa in 1916. It has since spread northwards and was reported in Nyasaland in 1937 and in Kenya in 1944.

PESTS OF STORED PRODUCTS.

Dried cassava roots in store near Masaka were seriously damaged by boring beetles. These included *Calandra oryzae* L. (*Curculionidae*), *Xyloperthodes* sp. (*Bostrychidae*), an unidentified *Bostrychid* and *Araecerus*

sp. (Anthribidae). The following beetles were feeding in the tunnels made by the borers:—*Gnathocerus cornutus* F. and *Tribolium castaneum* Herbst. (Tenebrionidae) and *Laemophloeus* sp. (Cujucidae).

Soya beans in store in Mengo district were heavily attacked by *Bruchus analis* Fab. (Bruchidae). The beans appeared to have a high moisture content which made them susceptible to attack by this beetle.

Dried salt fish (locally produced) in store at Katwe were found to be attacked by *Necrobia rufipes* de Geer (Cleridae) and *Dermestes vulpinus* F. (Dermestidae). Both these beetles are world wide in their distribution and commonly attack hides and stored meat products. Fresh stocks were found to be stored in contact with remnants of fish that had been two years in store and which were carrying a considerable infestation. It was considered that attention to warehouse hygiene would largely control these pests and appropriate recommendations were made.

During January and February bagged maize stored throughout Buganda in corrugated iron sheds was found to be heavily infested with a mixed population of insect pests. The chief primary pest was the weevil *C.oryzae* (Curculionidae). Larvae of the Angoumis Grain Moth, *Sitotroga cerealella* Ol. (Gelechiidae) and of the Rice Moth, *Corcyra cephalonica* Stn. (Pyralidae) were also present, and in some stores played an important part in breaking up the whole grain. Secondary pests feeding on the grain broken by these primary pests included the beetles *Tribolium castaneum* Herbst. (Tenebrionidae), *Carpophilus dimidiatus* Fab. (Nitidulidae), *Laemophloeus* sp. (Cujucidae), and *Tenebriodes mauritanicus* Linn. (Trogositidae). A rough survey of several stores in Kampala and Kyagwe districts indicated that the populations of *C.oryzae* averaged about 250,000 adults per ton of maize, and that over 50% of the seeds had been attacked. A particularly heavily infested store at Kagonda had an indicated population of 1,000,000 adult weevils per ton. (A ton of maize contains between 2,000,000 and 2,500,000 seeds). Sample weighings showed that up to 10% by weight of the grain had been destroyed. The heavy pest incidence was accompanied by an equally heavy incidence of parasitic Hymenoptera. These included species of Pteromalidae and Encyrtidae (Chalcidoidea) and of Aphidilinae and Cheloninae (Braconidae, Ichneuminoidea). Specimens of these parasites have been forwarded to London for more precise identification.

A small scale experiment of a preliminary nature was started in March to try the effect of various dusts in protecting whole maize against attack by the *C.oryzae*. The treatments consist of the following dusts applied at the rate of 1 part per 100 parts weight of maize:—

Uganda Rock Phosphate.

Kaolin.

Kaolin plus 4% by weight of DDT.

Wood ash.

The experiment is not yet complete and the results will be given in a later report.

MISCELLANEOUS.

The life histories of various insects were studied, and scale water colour drawings were made of larval stages for permanent record. The larvae were subsequently reared to the adult stage for precise identification.

Specimens were added to the Kawanda insect collection. Grateful acknowledgement is made of the work of the Imperial Institute of Entomology, in identifying Uganda insects.

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ANNUAL REPORT ON COTTON BY THE SENIOR BOTANIST, KAWANDA AREA.

Introduction.

Our knowledge of cotton in Uganda has now reached a state at which it is desirable to review the whole situation critically. Such a review is beyond the scope of the present report, and it is proposed to publish it as a separate article, which may come appropriately at a time when Corporation officers are beginning to arrive in the country. In anticipation of this review certain key conclusions are briefly mentioned at appropriate places in this report.

CONCLUSIONS FROM WORK DONE IN 1944-45.

Meteorology.

The following table records the rainfall at Kawanda in 1944, together with the average rainfall for nine years at Kawanda, and indicates the principal planting and harvesting months for cotton and food crops.

			Rainfall (ins.)		Planting	Harvesting
			1944	1936-44		
January	..	..	2.03	2.10	—	cotton
February	..	..	1.39	2.63	—	cotton
March	..	..	5.96	4.16	food	—
April	..	..	5.57	7.05	food	—
May	..	..	3.42	5.16	food	—
June	..	..	1.73	2.61	cotton	food
July	..	..	4.08	2.06	cotton	food
August	..	..	2.31	3.23	food and cotton	—
September	..	..	7.62	4.19	food	—
October	..	..	2.81	3.91	—	—
November	..	..	5.99	4.79	—	food
December	..	..	4.40	3.77	—	food and cotton
TOTAL	..	..	47.31	45.66	—	—

Rainfall was adequate and very well distributed, except that it persisted rather late and interfered with the beginning of the cotton harvest. The food crops, both early and late, did very well indeed. A high proportion of the cotton at Kawanda was planted full early, and in such a long season suffered severely from diseases and pests, with serious results to yield and seed viability.

Agriculture.

Rotations.—Results cannot be expected for some time to come.

Interplanting.—In abeyance.

Sowing Date.—This is a controversial subject in most countries where the climate allows any latitude, and Uganda is no exception to the rule. But it is a fundamental issue in deciding any cotton breeding programme. Formal experiments on the classical pattern have declared in favour of early planting (May and June), but owing to the possibility of cross interference by diseases and pests between adjacent plots it is necessary to accept this result with reserve. The actual distribution of cotton planting in Mengo District, in which Kawanda lies, during the ten years 1935-44 was as follows:—

May	...	5%
June	...	19%
July	...	31%
August	...	32%
September	...	12%

In spite of propaganda for early planting this distribution has shown no tendency to change, so it is clear that the peasant is prepared to accept the crop risk which we believe to be entailed by late planting. Therefore our past practice of breeding and testing varieties at comparatively early sowing dates has not been suited to the facts, and it now behoves us to adopt, as an important part of our programme, the more realistic plan of breeding varieties suitable for July and August planting and so help the peasant to minimise his crop risk.

During the period under review an attempt was made to grow, for observational purposes, some out of season cotton free from interference by *Lygus*. Isolated plots were planted at Kawanda in November, 1943, and February, 1944, using the blackarm resistant varieties KP 28 and S 1021 respectively. The November sown plot encountered the severest drought for many years and had to be established by watering. Three months after planting the plants were only four inches high, but after five months they had made excellent pyramidal growth, free from blackarm and *Lygus* attack, and had set a really excellent crop. The plants were uprooted in June unharvested, owing to the accumulation of stainers and bollworms during the close season for the normal crop, but the potential crop set provided valuable information nevertheless. The February sown plot was not so satisfactory, as it suffered severely from "new plot" effect, and growth was very uneven. On the better patches of soil the plants developed well and set a big crop. The bolls began to open about the same time as on the November sown plot, after which the plants were uprooted.

Planting Methods.—A two-acre increase field was divided into 20 plots, making five replications of the following factorized treatments:—

(a) 3 vs. 10 seeds per hole;

(b) 20 vs. 40 days to thinning.

Ten seeds per hole caused a reduction of 13% in yield, and 40 days to thinning a reduction of 16%. The effects were additive and the worst combination of treatments yielded 27% less than the best combination. Normally such clear confirmation of a simple agronomic result already worked out in detail at Barberton would be accepted as final. But owing to insect damage the mean yield of this field was only 257 pounds of seed cotton to the acre, so it is intended to repeat this experiment at some future date.

Genetics and Breeding.

Blackarm Resistance.—The transference of the gene B_3 from Gambia Native to BP 52 was discontinued on the grounds that such work would be more suitably done by Corporation staff. The rest of the gene transference programme proceeded according to plan. The amount of infection obtained by spraying with blackarm suspension was very unsatisfactory, and it was suspected that impurities in the Kawanda water supply might be responsible. In 1945 the suspension was made up with rain water, with entirely satisfactory results, and some of the more important transferences were repeated as a precaution.

Wilt Resistance.—The hybrid between KP 28 ex B 181 (resistant) and KP 40 ex BP 50 (susceptible) was selfed and back-crossed to both parents. The hybrid was also tested against its two parents in a variety trial comprising 27 replications of random threes, using single row plots. Each plant in the trial was inoculated with a culture of *Verticillium*. The percentages of plants which developed symptoms of wilt (after using a square root transformation) were as follows:—

	<i>External Symptoms during growth.</i>	<i>Internal Symptoms when uprooted.</i>
KP 28	... 0.25%	... 12.24%
KP 40	... 12.56%	... 38.13%
KP 28 × KP 40	... 3.05%	... 21.66%

The figures for the hybrid are close to the geometric means of the figures for the two parents. It is not possible to say whether they are the result of blending inheritance or a simple genetic system. A routine transference of resistance to BP 50 will now be attempted on lines suggested by Mr. Hutchinson, and the less promising work on Tanguis will be discontinued.

Seed Type.—Interesting information was obtained on this subject during the 1945 ginning season. The small departmental ginnery at Kawanda is operated by electricity. Working to capacity on a bulk which was largely clean seeded it consumed 32 amperes of current. Changing to a fuzzy seeded type on the same day under comparable conditions it consumed over 40 amperes.

It has always been recognised that a clean seeded type would be an advantage, because it is easier and therefore cheaper to gin, and would possibly reduce the number of particles of seed coat ripped off and passed into the lint. A clean seeded type is also easier to handle, packs more closely into bags, and germinates more readily than the fuzzy types. Unfortunately clean seeded types, considered uncritically and as a whole, give a lower ginning percentage. A transference of the tufted type (as opposed to the completely naked) to BP 52 will now be attempted, on lines suggested by Mr. Hutchinson, to see whether this type can be developed without impairing the ginning percentage. The completely naked type is also being transferred as a check.

Red Plant Body.—The gene responsible for the red type of plant which we have in Uganda has been identified by Mr. Hutchinson as R_1 . Harland⁽¹⁾ has shown that there is a low re-combination value between red plant body and cluster habit. It has been observed on several previous occasions that red plants in Uganda tend to be taller and more open in habit than ordinary green strains. The prevalence of cluster and semi-cluster habit in Uganda varieties will not be discussed in detail here. It is sufficient to say that this observation on red plants draws attention to it as a fact. But the red plants have drawn attention to another character prevalent in our Uganda varieties (by suppressing it) which is not ordinarily associated with cluster habit in the literature. This character is the tendency for dormant axillary buds to develop monopodial branches at any node on the main stem (alongside the sympodial branches), or even at the joints along the sympodia themselves. It is easy to see how this character, by providing a secondary structure for the plant, may compensate for the loss of framework caused by blackarm and *Lygus* damage. Two recent observations on red plants have provided the proof of this. A late planted plot at Kawanda, not attacked by blackarm or *Lygus*, produced large pyramidal plants with extensive sympodial branching and a big crop. An early planted plot at Serere, severely attacked by *Lygus*, and unable to make any secondary structure, produced tall columnar plants, reaching eight feet or more, with practically no crop.

Maintenance.—The importance of maintaining BP 52 in order to refresh commercial stocks cannot be over-emphasised. The relatively pure seed from Serere was grown on Kawanda main farm, and was also distributed to growers in Kawanda segregated area. The produce from the latter was sent to plant the 1945-46 crop in south Bugerere.

Last season 235 single plants were selected from BP 52 bulk for plant type, lint length and modal ginning percentage. The seed was planted out in progeny rows. After checking for the same characters, and also discarding for low hairiness, their number was reduced to 150. Seed of these was sent to Mr. Peat at Ukiriguru to be tested for jassid resistance, and a reserve

(1) HARLAND, S. C. (1934), *Tropical Agriculture*, 11, 316.

fumigated and put in store at Kawanda pending results from Ukiriguru. The remaining seed from these 150 progenies was made into a special bulk and planted in the 1945-46 season in an isolated increase field of rather over one acre at Kawanda.

Variety Trials.—25 varieties were tested in a lattice square at Kawanda. Three new departures were incorporated in this trial:—

- (a) the field was carefully levelled by hand before planting;
- (b) small square plots were used as recommended by Dr. Yates to meet our uniformity position;
- (c) planting was delayed until 12th July, to be more in accordance with local practice, although much of the farm was planted early as usual.

The levelling and change of design reduced error variance, though it was not possible to say how much each contributed to this result. The later planting reduced the amount of *Lygus* damage very considerably as compared with other earlier planted fields on the farm. The later planting and reduced *Lygus* damage between them increased the variety variance very greatly, spreading the varieties over a wide range of yield. This was very important, as it surmounted the difficulty that all varieties tend to yield alike when severely attacked by *Lygus*, and also indicated which varieties are likely to be of value when grown under conditions of ordinary local practice. BP 52 as control yielded 231 lbs. of clean lint per acre. The early maturing variety KP 40 ex BP 50, in spite of some wilt, gave 280 lbs. per acre. Derivatives of the late maturing variety B 181 averaged only 205 lbs. per acre. This was a perfectly logical result to obtain with later planting. 280 lbs. of clean lint to the acre is a good yield for an experiment station in Mengo District judged by absolute standards. Together with similar results obtained from time to time in the past it justifies the proposed plan of breeding early maturing varieties for late planting.

The five varieties BP 52, B 181, KP 28 (ex B 181), X 3/44 (a new mixture of three parts BP 52 and one part B 181) and BC 6/14 (a selection from a first back-cross from B 181 to BP 52) were tested in twelve district trials. Over all there were no significant differences in yield of clean lint, so little information was obtained on the variety question. But the trials were interesting from the point of view of sowing date. There were eight trials in Mengo District, after setting aside trials in outlying districts with different rainfall systems. Of the eight trials five were planted in May, and these all yielded considerably less than the three trials which were planted later. This result confirmed the general experience of the season at Kawanda farm.

Spinning Tests.—BP 52 gave the best spinning values from samples produced in the 1943-44 season. Mixtures and back-crosses containing elements of BP 52 made up the next best class. Nevertheless there is an increasing tendency to comment adversely on the appearance of BP 52 yarns. Samples of BP 52 are frequently immature and the fineness and spinning values which incorporate a correction for immaturity are not always good.

Seed Distribution.—The distribution of the mixture X 3/38 proceeded a stage further in Masaka District. Certain areas in the rest of Buganda received a new wave of BP 52 seed, the benefit of which was well marked in the routine examinations for seed purity in 1945. Seed purity is judged by the proportion of clean seeds which appear in ginnery stocks. BP 52 has a fuzzy seed, and the clean seeds derive from the old Buganda Local stock. Clean seeds have been sorted out and grown beside BP 52 at Kawanda. Nearly all the plants were manifestly off type, so the routine examinations, if not a straight measure of impurity, are something more than a mere index.

Plot Technique.

No new uniformity material was dealt with during the season. But a variety of designs were tried out in twelve experiments with different crops, not only for their efficiency in statistical analysis, but also for their convenience in day to day field operations.

Two uniformity trials have been laid down in the 1945-46 season and Mr. Manning is now available in Uganda to deal with them and previous results. So it is proposed to postpone further detailed discussion for the present. In general if the rows are planted along the contour a plot composed of numerous short rows is the most efficient for statistical analysis, but it entails the great practical disadvantage that it is necessary to walk forwards along the rows, instead of sideways to make a visual comparison between two plots.

Last year it was said that pronounced fertility changes were found in a gradientwise direction. It is not yet clear how much of this fertility change can be ascribed to defects in the planning of cultural operations, which could be remedied, and how much of it is inherent in the soil itself. For example if fields are ploughed so that an open furrow is left down the middle of each there will be pronounced fertility changes across the field. Careful levelling of certain fields before planting does seem to have improved the position materially, and it should not be impossible to organize ploughing so as to avoid this trouble.

Entomology.

Dr. Taylor's work on *Lygus* has now been published⁽¹⁾.

The most notable occurrence of the season was a severe infestation of stainers on Kawanda farm, which did great damage to the early planted crop and seriously impaired seed viability. The writer has not seen such a population before anywhere in Uganda. Unfortunately, owing to staff changes, continuous observations by an entomologist were not possible throughout the whole season. *Dysdercus superstitiosus*, *D. nigrofasciatus* and *D. fasciatus* all played some part. The last two were most conspicuous in numbers, particularly *D. fasciatus* at the end of season, but numbers are not necessarily a guide in assigning responsibility for damage done.

Mycology.

Natural infection by blackarm and wilt was not particularly serious. At Kawanda one field closed down with *Alternaria*, but for the good reason that it was carrying the heaviest crop on the farm.

⁽¹⁾ TAYLOR, T. H. C. (1945), *Bull. Ent. Res.*, 36, 121.

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ANNUAL REPORT ON COTTON BY THE BOTANIST, SERERE AREA.

Introduction.

The 1944-45 season was largely one of routine testing and of rounding off the work on Blackarm resistance. As usual the work on cotton was dominated by *Lygus* attack, which began later than usual so that cotton sown in April-May tended to escape damage until after flowering, but all cotton on the experiment farm except the very late sowings was severely attacked.

During this season exploratory work was started on cotton physiology with a view to elucidating certain aspects of *Lygus* attack.

CONCLUSIONS FROM WORK DONE IN 1944-45.

Meteorology.

Serere Rainfall (ins.)			Sowing		Harvesting	
	1944	Mean 1921-1944				
January	0.12	0.83	..	..	Food	Cotton
February	2.89	2.46	Food	..	..	Cotton
March	2.07	3.63	Food	..	..	..
April ..	7.30	8.10	Food	..	..	..
May ..	7.40	7.07	Food	Cotton	..	..
June ..	4.44	4.40	..	Cotton	Food	..
July ..	3.29	4.55	..	Cotton	Food	..
August	6.14	6.31	Food	Cotton	Food	..
September	8.46	5.87	Food	..	..	..
October	5.44	4.35	..	..	..	Cotton
November	7.14	3.90	..	..	Food	Cotton
December	3.63	2.10	..	..	Food	Cotton
Total ..	58.32	53.57	..	..	..	..

It will be seen from the rainfall figures above, that during the first eight months of the year there was no marked deviation from the average. On the other hand the second rains were both prolonged and heavy, the combined total of September, October and November outstripping that of April, May and June, an unusual distribution for Serere. These unusually heavy second rains undoubtedly favoured the growth of late-sown cotton and second rain crops generally, but damaged early-sown cotton to some extent.

Agriculture.⁽¹⁾

Manurial Trial.—This was in the third year of its fourth cropping cycle, manures having been last applied before the 1942 cotton planting. It was under groundnuts, the yields of which strongly reflected the dressings of farm yard manure. The plots with the largest dressings yielded almost three times the unmanured control.

Cotton Seed and Meal Manurial Trial.—Resting.

Cotton Seed and Ash Manurial Trial.—Resting.

Fertility Experiment.—Cotton crops were above average and responses to farm yard manure were well marked, especially in the second circuit of the rotation. *Eleusine* millet, considered a good indicator of soil fertility, gave a clear-cut increase in yield with increased resting period and decreased

(1) The assistance of Mr. R. K. Kerkham, Agricultural Officer, is gratefully acknowledged.

period of cropping. (The two treatments being complementary in the design of the experiment).

Interplanting Experiment.—It would be an undoubted advantage to the grower if cotton could be interplanted late in the year with a crop such as Cassava or Pigeon Peas, which would cover the land through the dry season after cotton harvesting, and, at the same time, yield a supply of food about the middle of the following year. This experiment was revised (*see* 1942–43 report, p. 100) to investigate the effect on cotton yields of this “telescoping” procedure.

Cotton was sown in mid-June and interplanted with Cassava and Pigeon Peas. Both of these crops were planted in August and October. The spacing of the cotton was the normal 3 ft. by 1 ft., the interplants being between rows and spaced 6 ft. by 6 ft. The results indicated that the earlier interplanting depressed cotton yield, but no depression of cotton yield was detected with the later interplanting. The “take” of the interplants was poor in October, nevertheless the procedure was justified since the cotton was unaffected, and extra food supplies gained.

N.P.K. Experiment.—This was repeated on the same land as in the previous year, the manures being reapplied to the same plots after sowing with cotton. The manures produced no significant differences in yield of seed cotton, and few of the field measurements carried out attained statistical significance. It is felt that the lack of uniformity of the land under trial rendered the experiment insufficiently precise to detect anything but very large responses, which were not likely to occur on land of high fertility status, such as this.

Genetics and Breeding.

Genetics of Blackarm resistance.—One hundred and fourteen selected strains, representing thirty-three varieties, were grown as small bulks for increase, and sprayed with “Blackarm suspension” as a further test for resistance. Thirty-one strains were eliminated for relative lack of resistance and other characters in the field. Finally, from a consideration of laboratory data, twenty-eight strains were selected for maintenance for possible use in the future, and thirteen for further increase.

Yields from these bulks were poor probably owing to a very severe attack by *Lygus*, so that the increase was less than was hoped. For this reason the quantities of seed available allow for the immediate testing of only twenty-four strains in variety trials here and at Kawanda.

Progenies from resistant phenotypes selected in the F_2 generation between BP 52 and resistant N 17 showed marked resistance and no further elimination for blackarm was necessary. The absence of susceptible plants in the F_3 implies that homozygous and heterozygous plants were distinguished and the former selected in the F_2 generation. Seed from F_3 is to be further increased in bulk.

Type Collection.—Maintained.

Variety Trials.—There were two variety trials. In the first, five varieties were compared at six sowing dates ranging from April to September. The results followed previous experience of these trials, the early sowing giving the highest yields of seed cotton. This was in spite of the very heavy late rains which presumably favoured the late-sown cotton⁽¹⁾. The Bukalasa strains B 181 and BP 50 R gave the highest yields at all but the latest sowing, when BP 52 was best, and N 17 derivatives the lowest yields at all sowings. The *Lygus* leaf damage counts revealed no varietal differences.

(1) The validity of sowing date trials is one of the subjects to be discussed in the article mentioned in the introduction to the Kawanda report.

In the second trial blackarm-resistant selections were compared with their parental less-resistant types. The relative resistance of the selections was well demonstrated by the routine lesion counts, the number of lesions being reduced to less than half. The best of the N 17 selections gave 255 lbs. of lint per acre as compared with 156 lbs. of lint per acre from the best N 17 local bulk. The highest yields were obtained from B 181 and its resistant derivatives, the best of which yielded 274 lbs. of lint per acre. The trial appeared to be heavily attacked by *Lygus*, but no varietal differences in this respect were revealed by the leaf damage counts.

District variety trials were conducted at nineteen centres. BP 52 and B 181 were tested against N 17 and the selection S 4105 (Ex N 17, M2) at all centres. In addition SP 84 (Ex U 4/4/2) was included in Usuku, the selections S 3104 (Ex N 17, M3) in Busoga and BP 50 R in the remaining districts. B 181 had fewer blackarm lesions than the other varieties at every centre, and BP 50 R, where it was grown, had fewer lesions than the remaining three. Once again B 181 had less blackarm than SP 84 in Usuku.

In general the highest yields of lint were obtained from B 181 which was equalled by BP 50 R at those centres where it was grown, but barely so by SP 84 in Usuku. BP 52 whilst considerably lower in yield than B 181 and BP 50 R almost everywhere, was the equal of, or better than, N 17 control. The N 17 mass selections were better than N 17 bulk in Mbale and Busoga, but little better elsewhere.

Out-pollination Test.—In 1943 an out-pollination test was performed using a few isolated green plants sown in a field of red cotton. In 1944 a less precise test was carried out to investigate the incidence of cross-pollination between plots of cotton separated by various distances. Use was made of the fact that the leaves of the hybrid between the okra-leaf type of cotton and the normal type are intermediate in form and therefore distinguishable from the parental types.

Small plots about 4 yards square were sown in various situations on the experiment farm being at various distances from other cotton plots. No other cotton was growing in the vicinity. The plots were harvested and two random samples of the seed of each grown in 1945 and the proportion of hybrids recorded. (See table below).

	Number of plants			% hybrid
	Okra type	Hybrid	Total	
1. Plot 3 ft. distant from nearest cotton on 2 sides ..	(1) 47	16	63	
	(2) 46	17	63	
	93	33	126	26.2
2. Plot 17 yds. from nearest cotton on three sides ..	(1) 68	1	69	
	(2) 53	3	56	
	121	4	125	3.2
3. Plot 70 yds. distant from nearest cotton on one side ..	(1) 68	4	72	
	(2) 74	0	74	
	142	4	146	2.7
4. Plot 140 yds. distant from nearest cotton on one side.	(1) 76	3	79	
	(2) 67	1	68	
	143	4	147	2.7

It should be mentioned that Plot 1, which was sown between two variety trials having red guard rows, showed a proportion of red hybrids. Of course all the red hybrids were also hybrid for the lacinate character. It is interesting to note that the 1943 out-pollination test with single plants gave a value of about 30%, only slightly greater than plot 1 in this trial.

Spinning Tests.—Samples from the 1943-44 crop showed that whilst BP 52 gave the strongest yarns throughout, they had poor appearance, whereas B 181 gave the weakest yarns everywhere except in Teso and Lango, but were good in appearance. The N 17 cottons gave in general yarns of intermediate strength and appearance.

Small scale tests again demonstrated the superiority of BP 52 over the Bukalasa and N 17 strains.

Seed Distribution.—The increase of improved N 17 through Mulondo and Labori-Kadunguru continued. Serere farm grew forty acres of B 181 destined to further the supply of seed to North Teso through Lalle. BP 52 reached the whole of Madi sub-district in the West Nile zone, and also the whole of South Mbale zone, replacing SG 29 in each of these areas. In 1945 BP 52 reached the whole of the West Nile zone, and also North Mbale zone, thus eliminating the last SG 29 in the country. The increase of B 181 is proceeding in North Teso.

Cotton Physiology.

This work was started with the aim of throwing light on the relationship between the cotton plant and the Capsid, *Lygus*. Previous work by Entomologists⁽¹⁾ in the Department has brought out the following salient features: (1) Only very young tissues are attacked. Mature tissues appear to be immune. (2) Old plants are less susceptible than young plants (3) Damage is increased in severity under humid conditions promoting saturation of the tissues with water. (4) In the field plants described as "succulent" are said to be attacked more than their "drier" neighbours. Readily attacked tissue must, therefore be immature, on a plant not beyond a certain age, and not in a condition of "water strain".

Whilst it is unlikely that there is a single unifying explanation of these facts, it was believed that the water factor might play an important part in *Lygus* attack. For this reason it was considered expedient to start by making a generalized study of the relationships between water and other leaf-tissue constituents; to explore the changes which occur during the maturing and aging of cotton plants; and to investigate the differences between young, mature and old leaf tissues found on a plant at a given time. In the work of this season most attention has been paid to changes occurring during the growth and aging of cotton plants, although preliminary data have also been obtained on the differences between young and old tissues.

Although mature tissues are not attacked by the insect, it was considered necessary to investigate some of the constituent relationships in mature tissue first, because the expanded lamina lends itself to more precise treatment than buds. It is hoped that this preliminary study of mature tissue will point the way to significant measurements on bud tissue, which might not have suggested themselves in a direct study of the latter.

In practice, discs of leaf lamina were punched with a cork-borer, a fixed number of discs constituting a sample. Such samples were taken periodically from the seedling stage to maturity in cotton plants sown on six different dates ranging from April to September. Thus at a given time plants of various ages were sampled, so that age and environmental effects could be distinguished.

(1) TAYLOR, T. H. C., (1945), *Bull. Ent. Res.*, 36, 121.

Whilst it would be premature to discuss the results in detail, the work of the first season has served to emphasise the importance of the choice of basis for expressing age and environmental changes in such leaf-tissue constituents as water or carbohydrates. Water expressed as a percentage of dry weight gave quite a different picture of water content trends from water expressed on an area sample basis.

Information gained, incidentally, on seasonal trends in leaf carbohydrates might throw light on the sowing date problem at Serere.

Entomology.

Taylor⁽¹⁾ states that in the Serere area the initial population of *Lygus* in cotton arises by dispersal from nearby millets. It was suggested, therefore, that the extensive millet cultivation on Serere experiment farm during the last ten years might have provoked an undue measure of *Lygus* attack on adjacent cotton. In order to test this no first rain millets were grown on the experiment farm this season, and a millet free zone was reserved on all sides of it. The nearest early sown millet from which *Lygus* might have dispersed was some Sorghum a quarter-of-a-mile distant. As far as could be seen by Mr. Mubbiru and botanical staff making general observations the *Lygus* attack was as severe as ever, and it would appear that this degree of segregation from millets failed to reduce the attack.

(1) TAYLOR, T. H. C. (1945), *Bull. Ent. Res.*, 36, 121.

MYCOLOGY.

Blackarm.—See genetics section.

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Botanist.

REPORT ON FOOD CROPS.

BY THE SENIOR BOTANIST AND THE BOTANIST, SERERE.

Eleusine.

Serere.—No experimental programme.

Kawanda.—The first crops ever grown at Kawanda were sown on Block II, 2 in February and March, using seed from Serere. Wild heads ("ekitu") appeared in the crop just as at Serere. This however does not prove conclusively that the seed supply was responsible.

Sorghum.

Serere.—(1943 second season). Seed of the varieties T 27 and L 33 was dusted with the spores of *Sphacelotheca Sorghi* before planting. Counts of infected plants confirmed the resistance of T 27 and the susceptibility of L 33, but did not reveal the genetic basis for resistance.

Kawanda.—No experimental programme.

Setaria.

SERERE.—VARIETY AND SOWING DATE TRIAL.

Yield of threshed grain: lbs. per acre.

	21 March	6 June	Variety Means
Variety—S 1	1,940	706	1,323
S 3	2,222	827	1,525
S 4	2,130	504	1,317
S 5	2,202	1,190	1,696
S 6	1,557	766	1,162
S 7	2,319	666	1,492
S 8	2,021	1,170	1,595
S 9	2,235	706	1,470
S 10	2,428	1,109	1,769
S 12	2,275	928	1,601
Sowing Date Means ..	2,133	857	1,495

Significant Differences: Varieties ... 87

Sowing Dates ... 165

Kawanda.—Observation plots sown in February yielded:—

S 7 ... 3,456 lbs. per acre.

S 8 ... 1,539 lbs. per acre.

S 9 ... 1,800 lbs. per acre.

Larger plots planted later in the year were stripped almost clean by weaver birds.

Groundnuts.

SERERE.—VARIETY AND SOWING DATE TRIAL.

Yield of unshelled nuts: lbs. per acre.

	28 Feb.	22 March	11 April	2 May	Variety Means
Local Spreading	1141	1031	492	119	696
S 185	1146	1034	542	76	699
Atuboi (Bunch)	1260	1141	620	81	775
B 239	1797	1362	757	128	1011
Sowing Date Means ..	1336	1142	603	101	795
Shelling %	63.9	67.4	68.5	59.9	
Rosette %	2.5	18.4	23.0	54.2	—

Significant Differences:	Varieties	...	100
	Sowing Date (yield)	...	213
	Sowing Date (shelling)	...	2.2
	Sowing Date (rosette)	...	16.6

VARIETY TRIAL NO. 2.

Yield of unshelled nuts: lbs. per acre.

Varieties (all bunch)		
Teso local	1286	
Busoga local	1565	
Atuboi (Lango)	1631	
Bunyoro local	1262	
West Nile local	1732	
Mubende local	1544	
Significant Difference ..	262	

The Atuboi variety (from the gombolola of that name) has been fostered at Ngetta for some 15 years. After some 12 years' effort it has been fairly generally distributed throughout Lango District, and is, to the best of our knowledge, the only named variety released in this country, excepting imported bulk seed.

KAWANDA.—VARIETY AND SPACING TRIAL (sown 27/28 March).

Yield of unshelled nuts: lbs. per acre.

	12" × 12"	12" × 6"	Variety Means
S 185	629	867	748
Atuboi	1049	1632	1340
B 227	1481	2009	1745
B 239	1359	2206	1783
Spacing Means	1129	1679	1404

Significant Differences:	Variety	...	135
	Spacing	...	137

VARIETY TRIAL NO. 2.

Variety			Sowing date	
Bukalasa Bunch ..	..	252	29 July ..	342
Atuboi ..	..	274	4 August..	169
B 227 ..	..	333	11 August..	349
Significatnt Difference ..	..	none		not rep.

Soya Beans.

Kawanda.—The irregular soil of Block III, 3 proved quite unsuitable for experimental work. Block II, 8 (plots 161–480 only) gave these results:—

VARIETY SPACING AND INOCULATION TRIAL (sown 23/24 March).

Yield of threshed beans: lbs. per acre.

			12"	6"	Variety Means
Venezuelan ..	..	963	819	891	
S 42 Serere ..	..	1,204	992	1,098	
S 42 Kawanda ..	..	1,132	1,091	1,112	
S 119 ..	..	1,003	1,179	1,091	
R 184 ..	..	1,122	1,297	1,209	
R 265 ..	..	1,012	993	1,002	
S 273 ..	..	1,175	1,164	1,169	
S 304 ..	..	1,090	1,198	1,144	
R 332 ..	..	1,031	1,169	1,100	
Dixie ..	..	1,073	1,109	1,091	
Plant Spacing Means ..	..	1,080	1,101	1,091	

Significant Differences: Varieties ... 90

(also differential response of varieties to plant spacing).

Effects which were not significant:—

Row spacing 2 ft. ...	1074	Control ...	1108
1 ft. ...	1108	Inoculated Seed ...	1074

Inoculation of the seed was done for the first time, without previous experience in technique, and caused a certain amount of swelling. It is presumed that this slightly impaired germination, because the yield disadvantage was entirely confined to the widest spacing (2 ft. by 1 ft.).

The residual effect on a subsequent crop planted on the same plots with uninoculated seed was considerable.

Control ...	682
Inoculated Soil ...	824
Significant Difference ...	40

VARIETY TRIALS NOS. 2 AND 3 (sown 17th July and 28th August).

Yield of threshed beans: lbs. per acre.

Variety			
S 42 Serere ..	..	628	
Monetta ..	..	561	
Hernon 29 ..	..	749	
Hernon 36 ..	..	789	
Significant Differences ..	..	183	
R 184 ..	..	771	
Mammoth yellow ..	..	594	
Hernon 5 ..	..	940	
Hernon 49 ..	..	994	
Significant Difference ..	..	213	

NAWANZU (BUSOGA).—SPACING TRIAL.

Yield of threshed beans: lbs. per acre.

Spacing.		
2 ft. $\times$ $\frac{1}{2}$ ft. say 30 lbs./acre	..	997
$1\frac{1}{2}$ ft. $\times$ $\frac{1}{2}$ ft. say 40 lbs./acre	..	963
1 ft. $\times$ $\frac{1}{2}$ ft. say 60 lbs./acre	..	957
1 ft. $\times$ 1 ft. say 30 lbs./acre	..	856
Broadcast say 90 lbs./acre	..	685

The last two treatments are significantly separated from each other and from the first three.

SERERE.—VARIETY TRIAL.

Yield of threshed beans: lbs. per acre.

Variety					Variety				
S 42	..	..	..	553	Hernon	5	..	..	453
S 113	..	..	..	462	"	6	..	..	745
S 119	..	..	..	379	"	18	..	..	671
S 256	..	..	..	531	"	29	..	..	571
S 263	..	..	..	505	"	36	..	..	523
R 265	..	..	..	244	"	49	..	..	640
S 273	..	..	..	301	"	286	..	..	375
R 332	..	..	..	318	Dixie	..	..	..	379

Significant Difference, 159.

Potatoes (Solanum).

KAWANDA.—OBSERVATION PLOTS (not replicated).

Yield of fresh tubers: tons per acre.

Sowing Date				March-April	July	September
Kigezi Blue	..	..	..	5.1	1.6	—
Toro Blue	..	..	..	3.4	—	5.3
Toro Blue (Kigezi)	..	..	..	3.5	2.4	4.9
Nyeri Early Purple	..	..	..	3.8	2.8	2.8
Nanyuki 1	..	..	..	1.5	0.7	1.6
Nanyuki 2	..	..	..	0.7	0.8	—
Nanyuki 3	..	..	..	2.0	0.6	2.4
Local	..	..	..	0.5	0.6	0.5
Local	..	..	..	0.8	—	—

Potatoes (Ipomoea).

Kawanda.—A condition resembling virus disease was first noted in March, 1944. As this might prove serious a considerable programme was framed, but there is of course nothing to report at this stage.

SERERE.—VARIETY AND SOWING DATE TRIALS.

1943 Yield of fresh tubers: tons per acre.

Sowing Date	20 April	27 May	26 June	26 July	Mean
era	0.7	1.0	2.6	0.3	1.2
di	0.8	2.8	4.4	2.3	2.6
keta	1.3	2.9	3.0	1.9	2.3
ngoit	2.3	3.3	3.3	1.4	2.6
oko	0.2	2.1	2.1	1.1	1.4
n	1.1	2.5	3.1	1.4	2.0

Significant Differences: Varieties ... 0.4

Sowing Dates ... 0.3

1944 Yield of fresh tubers: tons per acre.

Sowing Date	24 April	24 May	24 June	25 July	Mean
era	1.2	2.6	3.4	3.7	2.7
di	2.1	3.4	5.3	6.0	4.2
keta	2.2	4.1	5.9	5.8	4.5
ngoit	1.0	2.1	1.1	0.6	1.2
oko	2.1	1.1	3.2	1.8	2.0
n	1.7	2.7	3.8	3.6	2.9

Significant Differences: Variety ... 0.5

Sowing Date ... 0.4

Cassava.

SERERE.—TRIAL OF MOSAIC RESISTANT VARIETIES.

Yield of fresh tubers: tons per acre.

Lifting time (months)	9	11	13	15	17	Mean
di Minsi	1.3	4.6	5.6	7.6	9.0	5.6
zaze	2.0	3.0	6.0	7.2	9.1	5.5
ritius 29	1.4	4.4	4.8	6.7	6.5	4.8
ni	1.4	3.2	4.8	7.2	8.1	4.9
mba	1.1	4.1	5.8	8.1	7.8	5.4
ndi	1.6	5.3	7.3	9.6	10.0	6.8
zumbe	1.1	3.1	5.8	9.2	9.9	5.8
4 E	1.2	2.0	3.3	4.4	5.0	3.2
n Valenca	2.9	4.8	7.3	10.0	12.3	7.5
rah	1.8	4.1	6.2	6.9	10.6	5.9
bar	0.5	2.2	4.3	7.5	9.3	4.8
9	1.3	4.2	6.1	9.8	7.9	5.9
u	1.2	3.2	6.4	8.9	10.0	5.9
oko	2.8	5.9	6.8	8.7	7.8	6.4
rika tetraploid	1.4	3.4	5.3	6.3	6.9	4.7
rika tetraploid	0.6	1.5	2.0	3.5	3.3	2.2
n	1.5	3.7	5.5	7.6	8.4	5.3

The trial was planted at 4 ft. by 4 ft. spacing with alternate rows of diseased local material. "Local" was not lifted at 9 and 11 months. At 13, 15 and 17 months it averaged 1.9 tons per acre. At these dates the resistant varieties averaged 7.2 tons. Even this is a very conservative comparison, because owing to better growth the yield of the resistant varieties has been worked out on a basis of 8 ft. by 4 ft. spacing

(i.e., as though "Local" had not been there). The true comparison therefore is between 1·9 tons and some figure lying between 7·2 and 14·4 tons.

Palatability has been tested with the result that all the new material can be offered to the peasant cultivator, and some of it is definitely popular. On the basis of high resistance to mosaic, palatability and yield a short list of at least five new varieties can be released with confidence.

J. D. JAMESON,
Senior Botanist.

P. E. WEATHERLEY,
Botanist.

N.B.—When the three foregoing reports on cotton and food crops were written (pages 31 to 46), it was not known by the writers that the printing of the reports verbatim was to be resumed. The cotton reports contain a number of specific or implied references to previous reports. These have been published without interruption by the Empire Cotton Growing Corporation in their *Progress Reports from Experiment Stations*. The report on food crops is a progress record without comment written for the benefit of members of the Department who are familiar with the work.

ANNUAL REPORT ON EXPERIMENTAL WORK IN BUGANDA PROVINCE.

Bukalasa—General.

1. All work at Bukalasa was severely handicapped through shortage of labour. The increased requirements for the development of the Rural Assistants scheme rendered the position more difficult and even normal maintenance had to be curtailed. The growing inefficiency of labour and the poor daily turn-outs resulting from increased war bonuses in the first half of 1945, also added to the difficulties of maintaining a normal output of work.

2. The civil disturbances in January, 1945, also affected Bukalasa and all labour refused work for five days. There were no incidents during that period however and the strikers were on the whole well behaved. The farm was picketed however and although to begin with senior African staff assisted in the maintenance of essential work, latterly this devolved entirely upon the European residents.

Block E.—Cotton Manurial Experiment.

This experiment has now completed six cycles of cropping and the aggregate yields have been analysed by the Senior Botanist with the following results.

MEAN YIELDS PER CROP—LBS. PER ACRE.
1934—1945.

Treatments	Early Cotton			Groundnuts			Late Cotton		
	Control	G.M.	Means	Control	G.M.	Means	Control	G.M.	Means
Control ..	607	690	648	859	900	879	506	537	522
C.S. ..	749	737	743	954	902	928	663	598	630
Means ..	678	714	—	906	901	—	585	568	—

G.M. = Green Manure.

C.S. = Cotton Seed.

4. The analysis shows that the response to the cotton seed treatment is very significant in the case of Late Cotton and less so for Early Cotton. It is probable that Groundnuts have responded but the difference is not quite significant. None of the crops responded to Green Manure and there is no significant interaction between the two manures.

5. Owing to seasonal yield fluctuations, it cannot be shown whether the yields are tending to decline under any one treatment. Over the experimental plots as a whole however, it is now obvious to the eye that soil condition and structure have deteriorated very badly. The water absorbing capacity is low, and in wet weather water lies on the surface in hollows and in dry weather the soil compacts badly. Wash even within the narrow limits of the individual plots is severe and the whole area is terracing up behind the retaining inter-plot lines of Vetiver Grass.

Block S.1.—Grass Fallowing (Rotation) Experiment.

6. The normal programme of cropping has been followed. Rotation A—3 years cropping and 2 years grass fallow—has now completed its second rest cycle and is going down to cotton in 1945. Rotation C—3 years cropping and four years fallow—has completed one full rotation cycle and two cropping cycles. It is now entering the second cycle of fallowing.

Block G.1.—Shade and Ground Treatment.

7. The last analysis of treatment results was made in 1943, and since then the experiment has been undergoing regeneration of the banana shade and cover crop treatments. On account of severe die back on all unshaded plots stumping was done on all these plots at the break of the 1944 spring rains. Deaths resulting from this operation amounted to the low figure of 3% of the total population.

8. Regeneration of banana shade has been unsatisfactory. For that reason and because this treatment is already being examined at Kawanda and Gliricidia shade has proved highly unsuitable, it has been decided to abandon the experiment as such and to retain only one block for observation purposes.

Block N.2.—Coffee Shade, Ground Treatment and Manurial Experiment.

9. There are indications that there is a triennial cropping trend in this experiment as illustrated below.

Year.	Crude Yield Totals—Lbs. fresh cherry.	
1936	...	6,471 (maiden crop)
1937	...	27,518
1938	...	39,004
1939	...	116,276
1940	...	42,985
1941	...	31,973
1942	...	101,871
1943	...	9,522
1944	...	44,508

For this reason therefore, it has been decided to postpone further analysis of results until next season.

10. The unanalysed treatment yields for the 1944-45 season are as follows:—

Treatment.	Treatment Totals Lbs. fresh Cherry.	
{ Shade	...	14,382
{ No Shade	...	30,426
{ Cotton Seed Manure	...	22,426
{ No Manure	...	22,382
{ Half Mulch	...	12,251
{ Full Mulch	...	11,984
{ October-March Cover Crop	...	10,240
{ Clean Weeding	...	10,333

11. Without statistical analysis there is little comment to be made on these figures other than on the abnormally large difference in favour of No Shade. This is a reversion to the results of all previous seasons with the exception of 1943-44 when possibly in consequence of the very dry conditions prevailing during that year, the yield differences were in favour of Shade.

Block N.1.—Coffee Shade Observation Plots.

12. The *Cordia* and *Erythrina* shade plots were abandoned towards the end of the season as the stand was so poor that the treatments were equivalent to no shade. On the remaining plots yields have been recorded as hitherto.

13. For the second year in succession *Ficus* shade has taken the lead on both Robusta and Nganda plots although in the comparison of total yields for 8 seasons No Shade is better. The indications are that the beneficial effect of *Ficus* shade is only now beginning to become apparent.

Block G.—Land Use Observation Strips.

14. Normal cropping has continued on the permanent cropping strips (Nos. 1 and 2) and resting strips 5 and 6 have been grazed. All resting strips are in their last year of rest and will be opened up in 1946.

Demonstration Holdings.

15. *Holdings A and B.*—In view of the necessity of increasing food production for rations purposes, two of the cotton crops in the rotation were replaced by a food crop. Selected crop yields are as follows:—

Holding	Crop	Planting date	Yield per acre lbs.
A	Sweet Potatoes	12-8-44	12,291
B	" " " " " "	28-8-44	13,315
A	Cotton	30-6-44	703
B	" " " " " "	8-7-44	808
A	Cassava	29-7-44	12,082

The cotton yields recorded on these holdings were low for the season and compared unfavourably with yields from other cotton areas on the farm.

16. *Holdings C and D.*—Normal cropping was followed and the yields of the principal crops for which yields are available are detailed below.

Holding	Crop	Planting Date	Yield per acre lbs.
C	Cassava ($\frac{1}{2}$ acre)	2-3-44	37,648
	S. Potatoes ($\frac{1}{2}$ acre)	15-4-44	12,684
	Cotton	26-6-44	1,410
	Cotton	27-7-44	1,077
D	Cassava ($\frac{1}{2}$ acre)	3-3-44	35,072
	S. Potatoes ($\frac{1}{2}$ acre)	15-4-44	35,180
	Cotton	27-6-44	1,349
	Cotton	27-7-44	919
	Beans ($\frac{1}{2}$ acre)	3-4-44	816

17. The yields of cassava and sweet potatoes were high and at present day prices these two crops alone represent a considerable gross cash return. For example the total production of fresh cassava on both holdings was 18,180 lbs. which at 3 cents per lb. is equivalent to Shs. 545/40. Cotton yields also were very satisfactory on both holdings.

18. It is interesting to compare the yields of these root crops with those from the banana gardens. These are as follows:—

Holding	Yield per acre lbs.	No. of bunches per acre	Average bunch weight lbs.
C	7,176	494	14.5
D	9,918	505	19.6

19. Alternate row mulching is practised and the banana trash has been supplemented by cut elephant grass. Despite this attention, banana weevil damage was severe and it is suspected that this pest has originated from the abandoned bananas on the nearby holdings A and B. Control measures have been put in hand and there has been some diminution in the incidence of the pest.

Holding E.

20. Cropping and yields during the 1944-45 season were as follows:—

Plot	Crop	Planting date	Yield per acre lbs.
1	Cotton and	29-6-44	460
	Beans	18-8-44	226
	Groundnuts	28-3-45	864
2	Cotton	15-7-44	770
3	Cotton	29-6-44	826
	Maize	26-3-45	Not available
4	Cotton	27-7-44	500

21. The cotton yields were above average for this holding and reflect the wet weather conditions of the second half of 1944. The average yield of all four plots has been exceeded only four times since cropping started.

Livestock.

22. *Cattle*.—A small dairy herd is gradually being built up and four young heifers were bought locally during the year. A young bull from a good milking strain has replaced the old Lango bull. Health has been good.

23. The kraal on Holding C. has housed a number of oxen which are stall fed using a ration of cut elephant grass and cotton seed. This kraal has been *Stomoxys* proofed as far as possible and the animals have on the whole done well.

24. *Sheep*.—The sheep flock has been maintained at between 40-50 head. The natural increase has allowed of the slaughter of one per fortnight for station consumption. The wool bearing ram developed a septicaemia caused by tick bites from which it died. It had however covered a number of ewes and the progeny should be of interest.

25. *Pigs*.—Four pedigree Large Whites, one boar and three sows, have been taken over from Kawanda. All three sows have farrowed once since their arrival and there has been a keen demand for the young pigs. Sales have been confined so far to farmers selected by the Agricultural Officer, North Mengo. To avoid in-breeding an unrelated young boar has been purchased which will ultimately replace the present herd sire.

26. There are indications that this breed of pigs is prone to sun-burn. Even under the shady conditions of the present open air corral, sun-burn has caused trouble and made the animals more susceptible to the bites of *Stomoxys*. This restricts the utility of the breed among African farmers as close in-door penning with increased capital expenditure may be necessary.

The herd has thrived on meal mixtures made up from soya beans, maize and sorghum together with salt and lime.

27. *Poultry*.—Fresh blood has been introduced and a flock of pure bred Rhode Islands is being built up. The Australorps which are now somewhat mixed are being given up and it is intended to replace them with a light breed, possibly White Leghorns. There is a keen demand for sittings and young stock of reliable egg laying strains and it is hoped to produce these in quantity for sale.

Miscellaneous.

28. Kavirondo Sorghum is being tried as a substitute for elephant grass in the ley period of the rotation. Its suitability for this purpose is as yet unknown and it is too early to make comments.

29. Increase of Mosaic resistant varieties of Cassava of Kawanda and Serere origin has continued and planting material has been supplied to

district increase plots. Streak disease was identified by Dr. Storey at Bukalasa and on his advice all strains of Bukalasa origin were destroyed.

30. The Nsambya plantation has made fair growth despite unavoidable neglect through lack of labour and it has been possible to cut some poles for roofing rafters. Infestation by gall fly on the interplanted Mvuli has been severe but a weekly slitting of the galls resulted in a rapid diminution of the pest and the trees are now growing away from it.

31. The main Citrus orchard has been heavily pruned and the trees scraped clean of lichen and subsequently lime washed. Eradication of couch grass has continued and the whole orchard has again been manured. The young stocks planted two years ago are now making excellent growth.

Kakumiro.

32. For the purpose of providing facilities for the observation and increase of new crop varieties a portion of the Kakumiro land was laid out in six strips. The Kakumiro cotton variety trial was laid down on one of these strips. The large increase plot of cassava has also been maintained.

33. Observation plots of various crops were planted in the spring of 1945 from planting material supplied by the Senior Botanist. Yields obtained were as follows:—

<i>Crop.</i>		<i>Variety.</i>	<i>Yield per acre</i> <i>lbs.</i>
<i>Soya Beans</i>	...	No. 67	1,307
		R. 184	1,830
		No. 68	1,525
		No. 63	1,699
		No. 69	1,917
<i>Groundnuts</i>	...	Athuboi	2,126 (unshelled).
		Local	2,126 (unshelled).
		B. 227	2,544 (unshelled).
<i>Sim-sim</i>	...	Local I	314
		Kamod	105
		Local II	348
<i>Eleusine Millet</i>	...	Emiroit	639 (grain).
		Engomu	639 (grain).
		Ekwakoit	1,859 (grain).
		Emoru	1,336 (grain).
		Local	1,859 (grain).
		Engenyi	1,859 (grain).
<i>Sorghum Millet</i>	...	Local I	1,708 (grain).
		Local II	3,311 (grain).
		L. 1	3,136 (grain).

34. Out of twenty varieties of mosaic resistant cassava planted in the previous season only four were found to be sufficiently resistant under Kakumiro conditions for distribution. These were No. 7. 3724 E., No. F. 279, No. 14 Kru. and No. 15 Msitu. A total of 11,805 cuttings of these varieties has been distributed to growers.

35. An observation plot of 34 local varieties of sweet potatoes was planted to observe any inter-varietal resistance to the Sweet Potato virus disease recently noted by the Senior Botanist.

Kawanda—General.

36. In common with other areas of Buganda, Kawanda received good and well distributed rains during the second half of 1944 but the spring rains of 1945 were uncertain and on the whole inadequate. The total

rainfall in March was above the average for that month but was badly distributed; the April and June falls were the lowest on record.

37. There was an adequate supply of labour throughout the year and attendance was satisfactory. During the January disturbances the labour went on strike and strong measures had to be taken to deal with attempted violence.

Cotton.—1944-45 Crop.

38. The 20 acre increase and the Seed Farm was planted with B.P. 52 Seed of Serere origin. The supply of fresh seed was insufficient to plant the whole area and it was necessary to use one year old seed on three strips of the 20 acre increase. May and June planting was done. Yields were variable and the best performance was put up with June planted cotton which produced up to 917 lbs. per acre. Early planted cotton on Block IX on land grazed by cattle during the previous year yielded at the unexpectedly low rate of 253 lbs. per acre while early May sown cotton on Block X produced only 180 lbs. per acre.

Miscellaneous Crops.

39. *Manila Hemp*.—The plot of this crop has been maintained but growth has been unsatisfactory and only slightly improved by reducing the number of stems per stool.

40. *Maize*.—A plot of "Njoro", a slow maturing strain, was planted on Block I to maintain a seed supply. The yield was low and amounted to 1,263 lbs. of cob per acre. "Maratha" an early maturing maize planted on Block III yielded 2,231 lbs. of cob per acre.

41. *Sweet Potatoes*.—The collection of sweet potato varieties has been maintained and was re-planted on Block IX in April. The farm produced ample supplies of potatoes for all requirements during the year and the surplus was sold.

42. *Groundnuts*.—Increase plots of groundnuts, late planted in the spring of 1944, yielded poorly and the highest yield recorded was only 700 lbs. per acre of unshelled nuts. Growing conditions were more favourable in the autumn however and the most outstanding variety B. 227 yielded 1,337 lbs. per acre. The same variety in the spring of 1945 yielded 1,530 lbs. per acre.

43. *Soya Beans*.—Only three types have been increased during the year and the most outstanding strain is R. 184. Yields obtained were:—

No. 60	...	574 lbs. per acre.
No. 43	...	539 lbs. per acre.
R. 184	...	1,553 lbs. per acre.

Type No. 43 produced a high percentage of coloured beans and has now been discarded.

44. *Beans—Various*.—Increase and observation plots of numerous varieties were planted in the Autumn of 1944 and the Spring of 1945. The more outstanding yields are as follows:—

Variety.	Autumn Crop—1944		Spring Crop—1945	
	...	lbs. per acre.	...	lbs. per acre.
Mutike No. 4	...	590	...	1,646
Bukalasa No. 1	...	471	...	904
Bukalasa No. 2	...	286	...	775
Banja	...	362	...	1,135
Kagi	...	514	...	1,152
Namunye	...	800	...	950
Navy	...	—	...	1,017
White Kidney	...	348	...	1,100
Victory	...	395	...	1,039

As regards palatability, Bukalasa Nos. 1 and 2, Kagi and Namunye, appear to be the most popular varieties. Abundance, a climbing variety which shows promise of being a heavy cropper is also being bulked up.

45. *Bananas*.—The manurial observation plot of thirty-one varieties was maintained and yields indicated that applications of kraal manure increased production. The plot however has suffered severely from thieving and several varieties were heavily desuckered to provide planting material for the Senior Botanist's cultural experiment so that little reliance can be placed on the yield figures.

46. *Cassava*.—A strip on Block X was planted up with six mosaic resistant varieties for increase and observation purposes. Growth was satisfactory and one variety Namutiza was particularly interesting on account of its apparent deterrent effect on the growth of lumbugu. This is a red leafed variety casting dense shade and this characteristic may be responsible.

47. *Millets*.—A plot of Sorghum of the variety Namatera which was sown on the old Sugar cane plot yielded at the rate of 2,444 lbs. per acre. This is one of the highest yields recorded for this crop at Kawanda.

Fox Tail Millet (*Setaria italica*) was included in the rotation for the first time and was sown on two strips of Block IX. The average yield obtained was 1,742 lbs. per acre of threshed grain.

Elephant Grass Silage—Manurial Observation Plot.

48. This comprises eight observation plots on Block IV four of which are manured annually at the rate of 10 tons of kraal manure per acre and four are controls. Each plot is cut at four monthly intervals with the object of ascertaining the amount of silage it can provide and the extent to which elephant grass will stand up to regular cutting. Yields recorded show that the amount of silage is considerably increased by manuring, the average yield of the manurial plots being 49,800 lbs. per acre per annum as against 17,655 lbs. from the controls. So far there is no indication that regular cutting at four monthly intervals has any detrimental effect on the growth of the grass.

Animal Husbandry.

49. *Cattle*.—There has been a steady increase in the herd and during the year 18 calves were dropped. The health of both adult and young stock has been good on the whole. Five young heifers were purchased during the year and the herd now totals 77 animals.

50. The herd was inoculated against rinderpest in July, 1944. The reaction was severe and resulted in a lowering of milk production by milking cows and normal production was not resumed until November. Yields for the year averaged only 2.3 pints per cow per day although daily averages as high as four pints were reached.

51. Trials of stall feeding of store cattle continued but in the absence of a weighbridge results were inconclusive. There were indications however that complete stall feeding was superior to a combination of stall feeding and grazing. The incidence of *Stomoxys* has to be taken into account in this connection. The rate of feeding of concentrates was the same in both trials and it is possible that a higher rate for the grazing animals might have produced better live weight gains.

52. *Pigs*.—All the Large Whites were transferred to Bukalasa at the end of 1944 and the Large Blacks only were retained. Breeding has not been satisfactory and only one of the original Kenya bred sows has dropped and reared good litters. The other Kenya bred sow has farrowed well but her litters were weak and only four pigs were reared. Her two daughters were

equally disappointing and as the strain is obviously unsuitable for breeding it is being discarded and fresh gilts obtained from Kenya.

53. *Poultry*.—The two flocks of Rhode Island Red and Australorps were maintained but the former breed gave the highest average laying out-put per bird. The relevant records are:—

	<i>Rhode Island Red.</i>		<i>Australorp.</i>	
Total eggs laid	...	...	5,656	1,622
Average number of laying hens	...	...	35	15
Average number of eggs per hen	...	...	162	108

There was little trouble from disease during the year but losses from predatory animals were heavy and 34 birds were lost from this cause.

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ANNUAL REPORT ON EXPERIMENTAL WORK IN THE EASTERN PROVINCE.

1. Arabica Coffee.

1932 PLANTED CULTURAL EXPERIMENT.

The results of this experiment have just been analysed from its commencement by the Senior Botanist. While it is clear that the shade treatment has proved by far the best, and much superior to mulching when the labour requirements are considered, a further report will be submitted in due course giving further information from an agronomic point of view that can be extracted from this experiment.

1932 PRUNING AND SPACING EXPERIMENT.

Yields in cwts. cherry per acre are:—

1944			8'×8'	7'×7'	6'×6'	4'×4'
Unlimited terminal growth	..	..	25·62	25·87	36·53	15·44
Modified Multiple stem	..	..	27·86	26·29	16·93	13·28
<i>Total to date</i>	..	..				
Unlimited terminal growth	..	..	341·91	321·61	384·20	521·82
Modified Multiple stem	..	..	360·70	399·75	363·95	382·04

Unlimited terminal growth continues to show superiority at the closer spacings but is much more difficult to harvest, and there is an indication that quality is poorer. In 1944 the 4'×4' spacing showed inferiority to the wider spacings.

1941 SHADE AND MULCH NON-REPLICATED TRIAL.

Cordia is still the best shade, though the bad effects of *Croton* now seem to be diminishing since the tree has finished its early rapid growth. The ficus shade after a slow start has grown considerably.

1936 SPACING AND UPROOTING EXPERIMENT.

Total yields to date are as follows in cwts. of fresh cherry per acre:—

1944			3'×3'	4'×3'9"	5'×5'
Uproot alternate rows	..	..	10·41	7·01	5·47
Stump alternate rows	..	..	6·61	0·65	6·21
<i>Total</i>	..	..			
Uproot alternate rows	..	..	195·35	169·95	205·73
Stump alternate rows	..	..	192·45	214·57	198·38

Present indications are as follows:—

Uprooting.—The two wider spacings (now 10×10 and 8×7½) appear to be too wide. The 3×3 (now 6×6, the standard practice with existing type of coffee) is doing well. The 5×5 alternate row stumping has possibilities but in the closer spacings the new suckers develop as there is too dense a shade. So far, deaths from stumping have been remarkably few, even for those trees stumped more than once.

MISCELLANEOUS.

A new permanent pulper was built at Bugusege. The increase plot of Kents for seed supplies bore its first fly crop. Trials of wash breaks—Coleus, Vetiver, hairless elephant grass, Paspalum and Alternanthera continued. The Kenya everlasting sweet-pea, after a slow start is now very effective. Trials were also conducted with Madagascar butter beans and Masindi beans in young coffee to utilise the land and prevent weeds and wash.

2. Food Crops.

A large variety of new food crops were grown at plant introduction centres, at County Headquarters for testing of growth and palatability, and of these the following are being tested further or increased at one centre or another according to the possibilities of local popularity. The plant introduction centres were increased to 18 by the establishment of 5 centres in Karamoja.

Crop.	Remarks.
Indian Kale ...	Promises to be popular.
Tsama melon ...	Introduced as stock feed for dry areas. May also be suitable for human consumption.
<i>Setaria italica</i> ...	Considerable interest is shown in this as a crop, but palatability is still to be proved. This millet ripens rather more quickly than Eleusine; it will produce a crop under conditions rather too dry for Eleusine and may also be suitable for autumn planting; it is of doubtful value where birds are a great pest.
Uba cane ...	For gulley stopper that is also edible.
Pineapples ...	Buganda and Kitale types.
Soya beans ...	High and low level types.
Bulrush millet ...	Liked by birds, and the awned variety presents no advantage in this respect.
Maize, American yellow and Maratha.	
Various types of Beans.	
Various types of Sorghums.	
Mountain Pawpaw.	
Benares Cauliflower.	
Marrowfat peas ...	For local sale, replacing field peas.

Trial plots of *arrow-root* have been extended to test where it is economic to grow it, as it is possible that there might be a local post-war market for it. At Bugusege this crop yielded at the rate of 6,000 lbs. wet roots per acre.

Trials of *Sunflower* (large white seeded) were made at various centres in the marginal areas between coffee and cotton in Bugishu, as a possible economic crop. The average yield was about 600–700 lbs. per acre, plus a crop of beans if inter-planted. In view of a comprehensive report on market prospects by the United Africa Co., the project is not being pursued.

Trial collections of *Croton macrostachys* seed were made in Bugishu where this tree is plentiful. The seed was issued to the nearest oilmill, which conducted an experimental crushing, but its value as a soap oil *vis-avis* the cost of collection, coupled with considerable susceptibility to insect attack, does not warrant further efforts at the present stage.

Mass selection of *rice* has been commenced in Mbale and Busoga Districts with special reference to absence of blast disease, and other desirable qualities.

A *Soya bean* spacing trial at Nawanzu (Busoga) gave the following results:—

<i>Spacing.</i>		<i>Yield.</i>
A.	$2' \times \frac{1}{2}'$...	997 lbs. per acre.
B.	$1\frac{1}{2}' \times \frac{1}{2}'$...	963 lbs. per acre.
C.	$1' \times \frac{1}{2}'$...	957 lbs. per acre.
D.	$1' \times 1'$...	856 lbs. per acre.
E.	Broadcast ...	685 lbs. per acre.

Examination of results by the Senior Botanist showed that by partition and individual "Z" test E is far worse than the other treatments (1000:1), and B is worse than the remaining treatments (20:1).

Spacing within the row is more important than spacing between the rows giving the odd result that $2' \times \frac{1}{2}'$ is better than $1' \times 1'$ although the population is the same.

Rye, Linseed (Bugishu) and Chinese cabbage (generally) have proved a failure and trials have been discontinued.

3. Robusta Coffee.

Demonstration plots of Nganda and Robusta, shaded and unshaded in Busoga were maintained.

4. A full report on Serere Experiment Station for the year 1944/45 has already been published separately.

T. R. HAYES,

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ANNUAL REPORT ON EXPERIMENTAL WORK IN THE WESTERN PROVINCE.

1. Coffee Arabica.

(a) *Variety and shade* observation plots were maintained at Kyembogo Farm and at centres in Ankole, West Nile and Kigezi Districts. Both the Bushenyi (Ankole) and Kyembogo Farm plots (consisting of 12 varieties with and without shade) are now beginning to produce a crop, but *Antestia* has been particularly bad in the former plot.

(b) *Coffee shade plot Kyembogo Farm.*—All plots gave a fair yield but control (no shade) is still leading *Ficus* shade with Banana shade last. *Antestia* is very troublesome.

(c) *Kent's shade treatment and seed supply plot.*—Kyembogo Farm. This plot gave a satisfactory first crop. *Ficus* and Yellow Cassia still appear to be the most suitable shade trees. Actual yields, in lbs. of wet cherry, were as follows:—

	<i>Cordia abyssinica</i>	<i>Acrocarpus fraxinifolius</i>	Yellow Cassia	<i>Ficus</i>	<i>Erithrina</i>	Bananas	Control
Manured ..	96	98	77	48	51½	19	59½
Unmanured ..	61½	98	31½	44	53	15	28½

Bananas appear quite unsuitable as a shade tree.

2. Robusta Coffee.

(a) The demonstration plots of Nganda coffee at Bulindi planted in 1941 have given the following total yields since January, 1943:—

YIELDS IN LBS. WET CHERRY.

Banana shade		Mutuba shade		No shade	
Mulched	Unmulched	Mulched	Unmulched	Mulched	Unmulched
21·08	11·95	470·53	202·25	447·85	189·98

Both the shade trees and the coffee under the mutuba shade have made excellent growth, but the effect of mulch was a very noticeable factor in this year's yields, possibly on account of the dry weather during the past two seasons. The total yields of bananas in the banana shade plot since 1941 are:—Mulched 7,879 lbs., Unmulched 6,114 lbs.

(b) The observation plots at Ladonga and Nebbi in West Nile did not produce any crop and it appears as if this crop is quite unsuitable to West Nile conditions.

3. Tobacco.

(a) The fire-cured variety trial was continued at Bulindi Farm. Mosaic disease was much more widespread than usual and was particularly severe on Western (Bunyoro) and Blue Pryor (Bunyoro).

Yields per acre over the last three seasons are as follows in lbs.:—

Variety	1942	1943	1944	TOTALS
Western (Bunyoro seed) ..	292	260	172	724
Western (Nyasaland seed) ..	390	364	360	1,114
Blue Pryor (Bunyoro seed) ..	394	356	200	950
Blue Pryor (Nyasaland seed) ..	272	240	204	716

Yields in 1944 were again very low for Bulindi, but on the experience of the last three seasons it would seem as if the local Bunyoro Western seed does not produce such good yields as the Nyasaland imported Western seed. As more Western seed has been imported from Nyasaland this year for the commercial crop to be grown in the autumn, seed can be collected for use in the 1946 commercial crop.

(b) *Air-Cured Variety Trial*.—Results are as follows in lbs. of cured leaf:—

Variety	1943	1944	Totals
Jamaica Wrapper ..	550	160	710
Hickory Pryor (Nyasaland) ..	500	172	672
Piet Retief Swazie ..	450	324	774
Amorello ..	380	124	504

All varieties suffered considerably from leaf curl and mosaic disease but on the whole Jamaica Wrapper was the least affected, and as this variety had a very poor stand of plants yields were much reduced.

(c) *High Nicotine Tobacco*.—Experiments with various varieties of high nicotine content tobacco are proceeding in Kigezi to determine which variety yields the greatest bulk of leaf combined with a satisfactory nicotine content. The Brasilia and Olson 68 varieties of *N. rustica* received from the U.S.A. are at present very promising but it is too early yet to form a definite opinion as to whether they should be grown in the commercial plots.

4. Cinchona.

The 15.5 acres of *C. josephiana* planted in 1943 have been maintained at Kyembogo Farm. Growth has been very good; the one acre of 1' × 1' spacing has now reached the stage for harvesting.

Arrangements are in hand to plant up an additional 4 acres of *C. josephiana* at Kachwekano Farm.

5. Pasture Work Ngetta.

(a) *The Soil Rejuvenation Experiment (1939)* was continued and is designed to compare the effect upon soil fertility of (a) natural regeneration and (b) regeneration under a seeds mixture, when grazed and ungrazed. Results so far indicate that there is a tendency for yields of most crops following grazed to be higher than those following ungrazed. Similarly the resting period under *seeds mixture* appears to have conferred certain advantages as compared with *natural regeneration* but the differences are not so consistent. The stocking rate on the grazed land was at the rate of one adult ox per acre.

(b) *Grass Grazing Trials (1941 and 1942)* and (1944 and 1945) were continued. These trials are a replica of similar trials at Serere.

(c) *Seeding of Leys*.—Seeding leys has hitherto been carried out in the spring rains. An attempt was made in the autumn of 1944 to seed the ley under a nurse crop of short-term autumn-sown Mtama in the last year of the rotation before the land is due to be rested. The preliminary attempt to sow *Chloris gayana* at a seed rate of 30 lbs. per acre was not a success but the experiment will be repeated. A possible cause of the failure was the fact that the seed used was new; it is believed that the germination capacity of *C. gayana* improves with storage for a time.

(d) *Carrying Capacity of Ngetta*.—With the exception of a short period during April, 1945 when owing to the late arrival of the rains pastures were grazed down rather shorter than is customary, there was ample grazing and

the Ngetta pastures maintained the stocking rate of one beast per acre throughout the period under review. Thin cattle (mainly young bulls) added to the herd to replace aged oxen drafted out put on flesh rapidly and the general condition of the cattle throughout the period was good. Grazing by a fixed herd at the rate of one beast per acre has now been carried out at Ngetta without interruption since 1940. This period includes two of the severest dry seasons on record.

Miscellaneous.

(a) *Sunflowers*.—Small trial plots put down in Toro, West Nile and Kigezi to test the possibilities of this crop, especially where the altitude precludes the growing of a variety of oilseeds, gave satisfactory yields. In Arua where the land was poor the crop yielded at the rate of 1,400 lbs. per acre; at Kachwekano under similar conditions the yield was 1,050 lbs. per acre.

(b) *Beans*.—The Abundance Runner No. 1289 which gave yields of up to one ton per acre at Kyembogo Farm in 1944 has again given very high yields (actual figures not quoted here as they are open to correction) and considerably more than any other variety of bean so far tried.

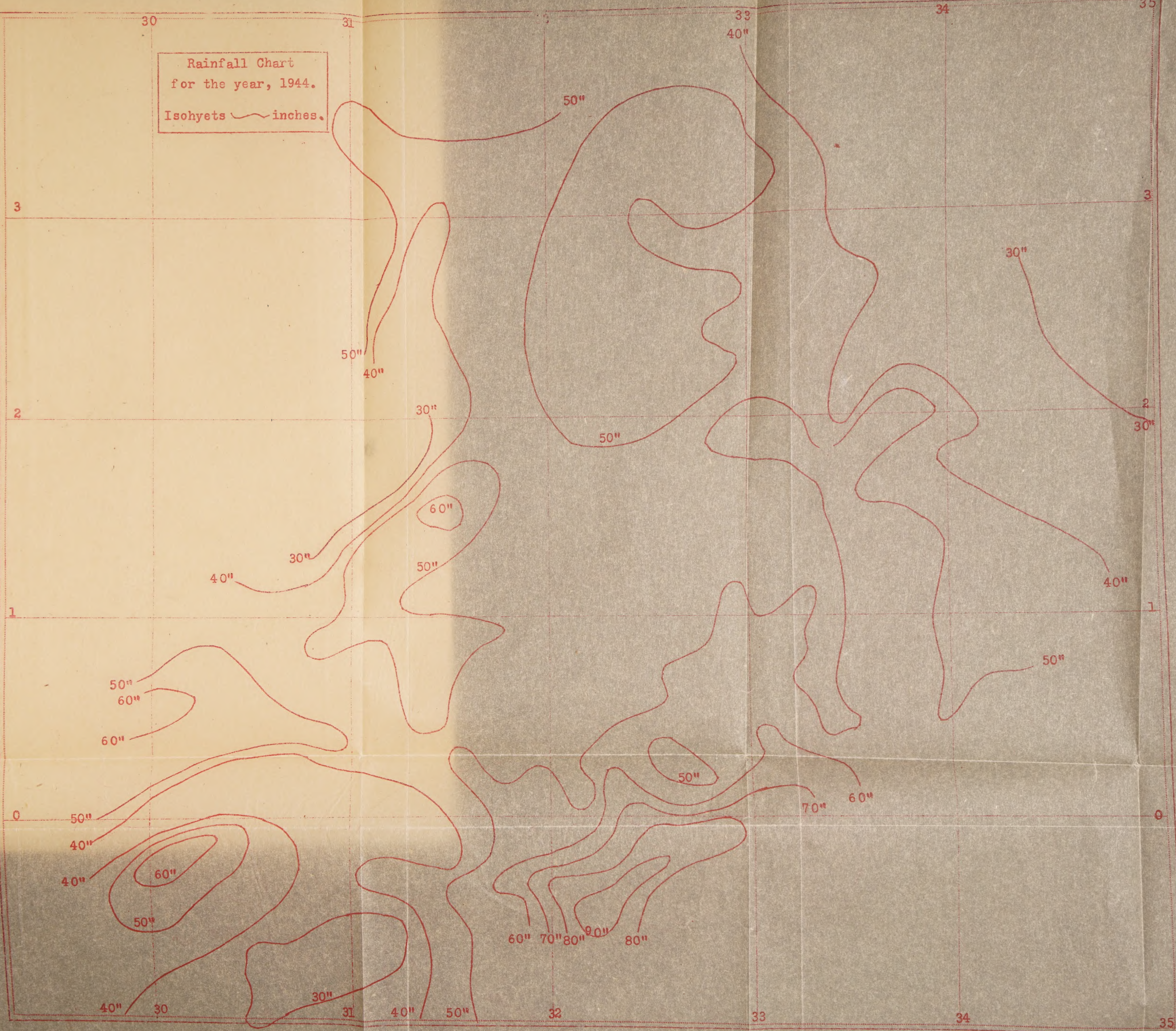
(c) *Wheat*.—Variety observation plots on Ruwenzori produced the following average yields:—

Kenya Governor 760 lbs. per acre. *B. 256G.* 742 lbs. per acre. *117A.* 600 lbs. per acre. The seed rate used was 120 lbs. per acre. Stem rust was not observed on any variety this year. *Kenya Governor* ripened a fortnight earlier than the other varieties.

(d) *Sheep*.—The flock at Kachwekano Farm has been very disappointing. The Romney Marsh Ram died during the year and there has been a heavy mortality amongst the cross bred lambs, both Merino and Romney Marsh, and only eight still survive. The reason for the many deaths is now proved to be caused by internal parasites due to the land becoming foul as a result of continual grazing by sheep.

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Rainfall Chart
for the year, 1944.
Isohyets ~ inches.



BRITISH EAST AFRICAN METEOROLOGICAL SERVICE

Average Annual
Rainfall Chart
(Revised 1945)
Isohyets, inches

Scale 1:2,000,000

Boundary

Railway

